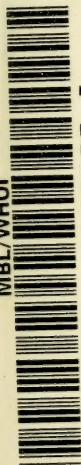






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E. YALE DAWSON



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REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS  
OFF THE COASTS OF SOUTHERN CALIFORNIA, MEXICO, CENTRAL AMERICA, SOUTH  
AMERICA, AND THE GALAPAGOS ISLANDS

MARINE RED ALGAE OF  
PACIFIC MEXICO

PART 7

CERAMIALES:  
CERAMIACEAE, DELESSERIACEAE

*By* E. YALE DAWSON



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MARINE RED ALGAE OF PACIFIC MEXICO  
PART 7  
CERAMIALES: CERAMIACEAE, DELESSERIAEAE<sup>1</sup>

By E. YALE DAWSON

The following is a continuation of the studies of Pacific Mexican Red Algae of which parts 1 and 2 have appeared in the *Allan Hancock Pacific Expeditions*, vol. 17 (Dawson 1953, 1954), parts 3, 4 and 5 in *Pacific Naturalist*, vol. 2 (Dawson 1960, 1961; Hollenberg 1961) and part 6 in *Nova Hedwigia* (Dawson 1962, in press).

The general features and some of the ecological relationships of the marine flora of Pacific Mexico have been presented elsewhere (Dawson 1944, 1949, 1951, 1959, 1961a, etc.) and a comprehensive annotated list of the species until recently recorded in the flora is also available (Dawson 1954a). A more recent summary of distributions is included in Dawson 1961b.

The specimens reported here represent the results of some twenty years of collecting, mostly on expeditions of the Hancock Foundation. It will be seen that the Mexican coasts north of latitude 23° have been moderately well covered. Collections from the more southern coasts remain spotty.

Unless otherwise indicated, representative examples of the collections are deposited in the Herbarium of the Allan Hancock Foundation in Los Angeles, and (or) in the Herbarium of the Beaudette Foundation now on loan at the Hancock Foundation. Partial sets have been distributed to the University of California, Berkeley; the Rijksherbarium, Leiden; University College, Auckland; University of Washington, Seattle; Rutgers University, New Brunswick; University of British Columbia, Vancouver; and others.

Distribution records are given in the text from north to south for the sake of consistency, the Gulf of California following Pacific Baja California.

All collections cited by number with the prefix "D." are in accord with the field notebooks of E. Yale Dawson. The dates of collection are as follows: 01-40 to 902-40, Jan., July 1940; 16-1094, Jan.-Feb. 1946;

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1095-1645, Apr. 1946; 1646-1989, May 1946; 2005-2165, June 1946; 2498a-2673 (W. Williams) Apr.-May 1946; 2756-3145, Oct. 1946; 3146-3581, Nov. 1946; 3582-3764, Dec. 1946; 3765-3940, Jan.-Feb. 1947; 3942-3976, 3982-4040, 4099-4113 (C. L. Hubbs & E. Flynn) Aug. 1946; 4041-4098, 4114-4162 (C. L. Hubbs) Dec. 1946; 5143-5312, Sept. 1948; 6462-7278, 7795-7810 Mar. 1949; 8124-8917, Dec. 1949-Jan. 1950; 9044-9554, Apr.-May 1950; 9624-10095, Apr. 1951; 10279-10288, Aug. 1951; 10289-10589, Oct.-Nov. 1951; 10672-10691, Dec. 1951; 10742-11040, May-June 1952; 12036-12176, Nov. 1953; 12239-12247, Apr. 1954; 12248-12542, Jan.-Feb. 1954; 13228-13606, Apr. 1955; 18545-18988, Apr. 1958 (first set in Herb. Los Angeles County Museum); 19191-19200 (K. Norris) Sept. 1952; 19201-19224 (K. Norris) Mar.-Apr. 1952; 19225-19286 (C. L. Hubbs) Oct.-Dec. 1957; 19287-19306 (C. L. Hubbs) Nov. 1954; 20154-20632, 20804-20949 (M. Neushul) Aug. 1957; 20991-21500, Apr. 1959; 21501-21536 (E. S. Reese) Aug. 1959; 21686-21753, Nov. 1960.

The photographs are the work of Don Ollis of Santa Barbara. The Latin diagnoses were kindly prepared by Dr. Hannah Croasdale. Thanks are also due to Miss Florence Ralph and Dr. Clinton Dawes for assistance in the research.

## Ceramiaceae

### Key to the Genera in the Pacific Mexican Flora

1. Thallus consisting of spongy, flabellate blades ..... *Haloplegma*
1. Thallus not spongy, without definitive blades ..... 2
  2. Final orders of branches or all branches uncorticated ..... 8
  2. Final orders of branches incompletely or completely corticated ..... 3
3. Cortication of branches differentiated into nodes and internodes 4
3. Cortication homogeneous from base to apex of branch ..... 6
  4. Corticating cells rectangular and in vertical rows ..... *Centroceras*
  4. Corticating cells polygonal and irregularly arranged ..... 5
5. All axes and branches corticated similarly .. *Ceramium* (in part)
5. Main axes fully corticated; ultimate branchlets corticated only by bands ..... *Spyridia*
  6. Branching distichous ..... 7
  6. Branching not distichous ..... *Ceramium* (in part)
7. Branching opposite and the two opposite branches unlike ..... 8
7. Branching alternate or pectinate ..... *Microcladia*
  8. Leaf-like branchlets smooth on one or both sides, of limited growth, not growing out into branches ..... *Neoptilota*
  8. Leaf-like branchlets serrate on both sides, not necessarily of limited growth, often growing out into branches .... *Ptilota*

- |     |   |    |
|-----|---|----|
| 9.  | Branching opposite or verticillate .....  | 10 |
| 9.  | Branching not opposite or verticillate .....  | 14 |
| 10. | Branching opposite, or, if verticillate, with all branches of<br>a verticil of about the same length .....                            | 11 |
| 10. | Branching verticillate, each verticil with two long and two<br>short branches ..... <i>Platythamnion</i>                              |    |
| 11. | Branching opposite .....  | 12 |
| 11. | Branching verticillate .....  | 13 |
| 12  | Tetrasporangia terminal on ordinary lateral branchlets<br>..... <i>Gymnothamnion</i>  |    |
| 12. | Tetrasporangia abaxial or adaxial on branches or branch-<br>lets ..... <i>Antithamnion</i> (in part)                                  |    |
| 13. | Thallus mucilaginous, the lateral branchlets compactly<br>arranged to form a cylindrical axis ..... <i>Crouania</i>                   |    |
| 13. | Thallus not mucilaginous, the lateral branchlets loose, not<br>forming a definitive cylindrical axis .. <i>Antithamnion</i> (in part) |    |
| 14. | Branching regularly alternate .....   | 15 |
| 14. | Branching not regularly alternate .....   | 17 |
| 15. | Tetrasporophytes with tetrasporangia .....  | 16 |
| 15. | Tetrasporophytes with polysporangia ..... <i>Pleonosporium</i>  |    |
| 16. | Gonimoblast formed of $\pm$ spherical or rounded gonimo-<br>lobes; cells plurinucleate ..... <i>Callithamnion</i>                     |    |
| 16. | Gonimoblast cordiform, or of angular or lobed gonimo-<br>lobes ..... <i>Aglaothamnion</i>   |    |
| 17. | Branching predominantly dichotomous ..... <i>Griiffithsia</i>   |    |
| 17. | Branching not predominantly dichotomous .....   | 18 |
| 18. | Plants minute; cystocarps with pericarp-like investment<br>..... <i>Lejolia</i>   |    |
| 18. | Plants larger; cystocarps without loose cellular investment   | 19 |
| 19. | Rhizoids penetrating the host, much swollen ..... <i>Tiffaniella</i>  |    |
| 19. | Rhizoids simple, with discoid ends ..... <i>Spermothamnion</i>  |    |

*Gymnothamnion elegans* (Schousb.) J. Ag.

Pl. 1, fig. 1-3

J. Agardh 1892, p. 27; Setchell & Gardner 1930, p. 167; Taylor 1945, p. 265.  
*Callithamnion elegans* Schousboe, in C. Agardh 1828, p. 162.

Thalli consisting of a creeping axis giving rise to erect, plumose, percurrent axes about 2 mm high; prostrate axes about 20  $\mu$  in diameter, of cells about 1.5-2.5 diameters long, attached at frequent intervals by short pluricellular, simple or branched rhizoids; erect axes percurrent, 15-20  $\mu$  in diameter, with a distichous pair of opposite, determinate branchlets from each cell, or sometimes a conspicuous lower part of the axis barren of branchlets; determinate lateral branchlets of somewhat irregular length, consisting of 6-13 cells, somewhat attenuated, usually

slightly recurved, blunt-tipped, simple or provided with a few short adaxial branchlets; gland cells absent; tetrasporangia ellipsoid, 12-17  $\mu$ , surrounded by a thick gelatinous envelope about 5  $\mu$  thick, variously situated, terminal on primary lateral branchlets and (or) adaxial on these, sessile or pedicellate; sexual reproduction unknown.

TYPE: Holotype is a Hornemann collection from Herb. Schousboe, probably in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: "Ad Tingin" = Tangiers, North Africa.

PACIFIC DISTRIBUTION: *California*—D. 5507, Santa Catalina Island. *Revillagigedo Arch.*—D. 13754, intertidal, Binners Cove, Isla Socorro; Mason 32, Isla Clarión. *Galapagos Arch.*—Taylor 34-120, Isla Isabel.

This seems to be a widespread but inconspicuous plant of warm waters in the Atlantic and Pacific, easily recognized by its tetrasporangia which are at least partially terminal on the determinate laterals.

It should be noted that Yamada and Tanaka (1934) have described a plant as *Plumaria ramosa* which shows many resemblances to the present species and should be taken into account in further studies of this group.

### Platythamnion

This artificial genus, set up by J. G. Agardh (1892) based upon *P. heteromorphum* and *P. orbigniana*, and elaborated by Kylin (1925), segregates several species from *Antithamnion* on the basis of the whorls of four determinate branches from each main axial cell in which one opposite pair of each whorl is much smaller than the other. The genus merges with *Antithamnion* in the distichous species *A. plumulum* which in Europe and in Japan produces a partially tetrastichous variety (*A. plumulum* var. *crispum*) that is almost identical with the Pacific plant known as *Platythamnion pectinatum*. *A. plumulum* var. *crispum* apparently differs from *Platythamnion pectinatum* only in that the opposite pairs of dwarf lateral branchlets are of inconsistent occurrence, and do not, even when in maximum development, extend regularly to the tips of the main axes. Feldmann (1937) treated *A. plumulum* var. *crispum* as *Platythamnion crispum*, but G. Feldmann-Mazoyer (1940) returned it to *Antithamnion* in agreement with Daines (1913) who contended that the identity of the development of the carpogonial branch and the gonimoblast in *Antithamnion* and *Platythamnion* was such that the vegetative differences were not sufficient to justify generic distinction.

Recently, Sundene (1959) has cultured and crossed strains of *A. plumulum* and shown that a distichous Plymouth strain and a tetrastichous Oslofjord strain are intersterile.

The nomenclatural problems surrounding *Platythamnion* have been



extended by the failure of Japanese algologists to deal clearly and effectively with the plant treated by Okamura (1922) as *Antithamnion plumulum*. According to his figure and description, both the distichous *A. plumulum* var. *plumulum* and the tetrastichous *A. plumulum* var. *crispum* occur in Japan. Inagaki (1950, p. 25) treated Okamura's Japanese *P. plumulum* as synonymous with his *P. yezoensis*, but without pointing out distinctions from the European plant. Furthermore, Inagaki, Tokida, and Tokida & Inabu have described new Japanese species of *Platythamnion* without providing further comparisons with this incompletely tetrastichous *Platythamnion*-like plant of Okamura. Indeed, Tokida has gone so far as to describe *Platythamnion intermedium* of which he says: "The transversal branches are usually smaller than the lateral ones, but not so markedly diminished in size as in most *Platythamnion* species. In this respect at least it cannot easily be decided whether *Platythamnion intermedium* would belong to which of the two allied genera, *Antithamnion* or *Platythamnion*."

In view of these considerations the following key to the known species of *Platythamnion* should be treated as an aid to their recognition in relation to the closely allied *Antithamnion plumulum* var. *crispum*.

1. Axes bearing on each cell tetrastichous branchlets in dissimilar opposite pairs throughout their length from base to apex.  
..... (*Platythamnion*) 2
1. Axes bearing tetrastichous branchlets in dissimilar opposite pairs, but not on every cell, or at least not consistently all the way to the apex .....  
..... *Antithamnion plumulum* v. *crispum* (Ducluz) Hauck
2. Longer pairs of lateral branchlets bearing 4 quadrately arranged subultimate branchlets from each cell, at least the more basal ones ..... 3
2. Longer pairs of lateral branchlets bearing 1, 2, or 3 branches from each cell ..... 4
3. Quadrately arranged subultimate branchlets of younger parts  $\pm$  symmetrical from each cell, the upper and lower pair of about equal size ..... *P. heteromorphum* J. Ag.
3. Quadrately arranged subultimate branchlets of younger parts asymmetrical, the lower of each vertical pair much longer than the upper ..... *P. reversum* Kylin
4. Longer pair of lateral branchlets bearing, at least near their base, 3 subultimate branchlets from each cell, 2 on the upper side and one on the lower ..... *P. villosum* Kylin
4. Longer pair of lateral branchlets bearing only 1 or 2 subultimate branchlets from each cell ..... 5

5. Longer pair of lateral branchlets bearing subultimate branchlets only on the upper side ..... 7
5. Longer pair of lateral branchlets bearing 1 row of branchlets on the upper side and one on the lower side ..... 6
6. Adaxial ultimate branchlets tending to develop earlier and to be more prominently developed; spermatia in low, mounded clusters, the spermatangia of 1-2 cells .....  
..... *P. orbigniana* (Mont). J. Ag.
6. Adaxial ultimate branchlets tending to be more prominently developed; spermatia in elongated, cylindrical clusters, the spermatangia of 2-3 cells ..... *P. tepocensis* Dawson
7. Branchlets all very short, spine-like .....  
..... *P. horridum* Tokida & Inaba
7. Branchlets  $\pm$  subulate, not especially short ..... 8
8. Smaller pair of lateral branchlets not much smaller than larger pair ..... *P. intermedium* Tokida
8. Smaller pair of lateral branchlets very markedly dwarfed, shorter or less developed than the larger pair ..... 9
9. Smaller pair of lateral branchlets simple to multifariously branched from the basal cell ..... *P. pectinatum* Kylin
9. Smaller pair of lateral branchlets pinnately branched .....  
..... *P. yezoensis* Inagaki

### **Platythamnion pectinatum Kylin**

Pl. 1, fig. 4 a-c; Pl. 4, fig. 2-3

Kylin 1925, p. 53, fig. 32D, 33E, 34A-C; Smith 1944, p. 316, pl. 79, fig. 1; *Platythamnion pectinatum* var. *laxum* Taylor 1945, p. 226.

Thalli 1-2 cm in extent or more, the lower parts partially prostrate, attached by multicellular branched rhizoids; principal axes irregularly branched at intervals of 3-7 cells, 150-200  $\mu$  in diameter, mostly of cells 1-1.3 diameters long and approximately equal above and below; all principal axes provided at each axial cell node with 4 determinate branches of 2 kinds: one opposite pair of compound, ascending, long laterals and an opposite pair of shorter dwarf laterals; long pair of determinate laterals of about 9-12 cells 22-24  $\mu$  in diameter at the base and about 2 diameters long, sharply pointed, sometimes attenuated, the cells of approximately equal proportions except the basalmost which is somewhat shorter, provided with branchlets only on the adaxial side: usually 2 compound branchlets from the first 2 or 3 cells and a single compound or simple one from the next 4 or 5 cells; all ultimate branchlets from the adaxial side of the bearing branchlet, sharply pointed; short determinate laterals consisting of a subspherical basal cell usually bearing 3 (5-6) simple or forked compound branchlets, the uppermost one longest, often of 5 cells; gland

cells abundant both on long and short determinate laterals, on ultimate or subultimate branches, lying on a single cell, sometimes serially on adjoining cells; tetrasporangia ovoid, 30-40  $\mu$  long, sessile or pedicellate, usually in a group on the lower compound branchlets of determinate laterals; spermatia in small adaxial pedicellate clusters on (or replacing) branchlets near the base of determinate laterals.

TYPE: Not specifically designated: represented by several syntypes probably in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: Not specifically designated: Friday Harbor, Canoe Island, and Peavine Pass [Puget Sound, Washington], dredged at 5-10 fathoms.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8268, 8472 (70-80 m.), D. 8431a (50-60 m.) Isla Guadalupe. *Gulf of Calif.*—D. 6837 (20 m.) Bahía San Lucas. *Revillagigedo Arch.*—A.H.F. Sta. 135-34, Jan. 5, 1934, Bahía Sulphur, Isla Clarión, (50 m.)

Reexamination of liquid isotype material of Taylor's *Antithamnion pectinatum* var. *laxa* shows this to be a somewhat lax and attenuated form represented in our collections from Isla Guadalupe. D. 8431 from that locality represents an extremely attenuated form of this in which the determinate laterals become somewhat flagellate and to 16 cells long.

The close relationship between this species and the European *Antithamnion plumulum* var. *crispum* has been pointed out above; indeed, one collection, D. 8267 from Isla Guadalupe is here assigned to *Antithamnion plumulum* (see below) because of its infrequent or only occasional production of short, spine-like determinate branchlets in a plane at right angles to the regular distichous laterals.

### *Platythamnion tepocensis* Daws.

Pl. 2

Dawson 1944, p. 314, pl. 72, fig. 1

Thalli to 3 cm high or more, the attachment unknown, consisting of irregularly branched primary axes 50-70  $\mu$  in diameter above, to 150  $\mu$  in diameter below, giving rise at each axial cell node to a whorl of four determinate branches of two kinds: one opposite pair of compound ascending long laterals and an opposite pair of relatively simple dwarf laterals; cells of main axis mostly two diameters long except the shorter basalmost one, attenuated, the tips acute, simple or commonly producing both adaxially and abaxially simple pinnae; short determinate laterals simple or consisting of 2 or 3 spreading branchlets about 60-100  $\mu$  long from a rounded basal cell; gland cells frequent on determinate laterals, lying along a single cell; spermatangia replacing some of the opposite, alternate branchlets of the long laterals, consisting of 2-3 cells producing a short cylindrical cluster of spermatia; other reproduction unknown.



TYPE: Holotype is Dawson 379-40, Feb. 4, 1940, in Herb. Allan Hancock Foundation 54.

TYPE LOCALITY: Dredged in 22 meters, sandy bottom with abundant worm-tubes etc. at Tepoca Bay, Sonora, Mexico.

MEXICAN DISTRIBUTION: A single collection, D. 20528 (M. Neushul) from a depth of 115 feet, Bahía Viscaíno, seems to be this species but is very small and apparently not fully developed.

This species appears to be closely related to the Peruvian *P. orbigniana* (Mont.) J. Ag. Well preserved specimens will be needed, however, to determine the details of branching structure and reproductive apparatus in order to make effective comparisons between these plants from widely separated areas. An examination of part of Montagne's type has revealed none of the short "dorsal and ventral" branchlets, and it may be presumed, in accord with Howe's account, that these are indeed "rudimentary" and incompletely developed, perhaps occurring mainly in lower parts.

***Platythamnion reversum* (Setch. & Gard.) Kylin**

Pl. 1, fig. 4 d-f

Kylin 1925, p. 54, fig. 34 d-f. *Platythamnion heteromorphum* f. *reversum* Setchell & Gardner 1903, p. 345, pl. 25.

Thalli to 2 cm in extent or more, the lower parts partially prostrate, attached by numerous slender, multicellular, branched rhizoids mostly arising from the basal cell of the ventral short determinate laterals, consisting of an irregularly branched primary axis of cells to 300  $\mu$  in diameter below and about 2 diameters long (shorter above), and giving rise at each axial cell node to 4 determinate branches of two kinds: one opposite pair of compound, ascending long laterals and an opposite pair of much shorter dwarf laterals; long pair of determinate laterals of 8-12 cells ( $\pm 500 \mu$ ) long, the cells about 1.5 diameters long, rigid, little attenuated, compound, with a whorl of 4 secondary branchlets from each cell node, these in part with pinnate or secund ultimate branchlets all sharply reduced to a point, the longer ones adaxial and abaxial, and with the abaxial ones developing earliest and reaching greatest development; short determinate laterals consisting of a subspherical basal cell producing a spinose,  $\pm$  radiating group of short, forked, attenuate branchlets; gland cells infrequent and inconspicuous on ultimate branchlets, sometimes apparently absent; tetrasporangia subspherical, about 35  $\mu$  in diameter, pedicellate on 1 or 2 cells replacing ultimate branchlets on the long laterals; other reproduction not seen.

TYPE: Not specifically designated, cited as N. L. Gardner 8 and 621, probably to be found in Herb. University of California, Berkeley.

TYPE LOCALITY: West coast of Whidby Island, Washington.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 21563, Isla San Esteban, 10-40 m.



Taylor's *Platythamnion reversum* var. *laxum* from the Galapagos Islands lacks the distinctive characteristic of *P. reversum*, namely the 4-ranked branchlets of the determinate laterals, and seems much more closely related to *P. orbigniana* from Peru, to which it should be referred for more critical study.

***Platythamnion heteromorphum* J. Ag.**

Pl. 4, fig. 4

J. G. Agardh 1892, p. 23; Smith 1944, p. 315, pl. 79, fig. 3.

Thalli to 2.5 cm in extent, consisting of a primary distichous axis with indeterminate branches at intervals of about 4 cells, attached by branched, multicellular rhizoids from lower decumbent parts of the axis; primary axis about 150-200  $\mu$  in diameter, of cells 1.5-2.0 diameters below, 1.0-1.5 diameters long above, provided near the distal end of each cell node with a whorl of 4 determinate branches: one opposite pair 400-600  $\mu$  long, the other dwarf and consisting only of a few branchlets to 60  $\mu$  long from the basal cell; long determinate laterals of 12-16 cells mostly 1.5 diameters long, each provided with an opposite pair of equal, symmetrical secondary branchlets on the adaxial and abaxial sides, these in turn pinnately branched; all ultimate branchlets acute; gland cells mostly on the ultimate branches, lying on a single cell; tetrasporangia subglobose, 28-30  $\mu$  long, 24-27  $\mu$  broad, born on the pinnate branchlets of the long laterals; other reproduction not seen.

TYPE: A collection by C. L. Anderson in the Agardh Herbarium, Lund, Sweden. An isotype slide is in Herb. Allan Hancock Foundation.

TYPE LOCALITY: Santa Cruz, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 7978, Cortez Bank, 40-50 m.; D. 8448, Isla Guadalupe, 95 m.

This is a readily recognized, distichous species which appears complanate because of the prominent, symmetrical development of the long laterals and the very limited development of the short laterals.

***Platythamnion villosum* Kylin**

Pl. 3, fig. 1; Pl. 4, fig. 1

Kylin 1925, p. 51, fig. 32 a-b, fig. 33 a-d; Smith 1944, p. 315, pl. 79, fig. 2; Dawson 1944, p. 342.

Thalli to 6 cm in extent or more, consisting of an irregularly branched primary axis to 150-300  $\mu$  in diameter, the branches alternating at intervals of 3-8 cells, giving rise at each axial cell node to a whorl of 4 determinate branches of 2 kinds: one opposite pair of ascending long laterals and an opposite pair of short laterals; cells of main axis about 2 diameters long, shorter above, the determinate laterals arising from near the distal end; long pair of determinate laterals 6-9 cells long, each cell except the terminal ones bearing 3 simple or compound branchlets, 2 on the upper side, and one on the lower

side (some of the latter often suppressed), all about the same length, the tips sharply pointed, little attenuated; short determinate laterals 3-4 cells long, oppositely branched; gland cells on the ultimate branchlets, lying along a single cell; tetrasporangia broadly ellipsoidal, sessile or pedicellate, 25-34  $\mu$  long, 18-25  $\mu$  broad, on the long determinate laterals; "gonimoblasts sessile on the upper branches;" spermatangia in small clusters replacing ultimate branchlets of both long and short determinate laterals.

TYPE: Collections by Kylin not specifically designated, represented by several syntypes probably to be found in the Agardh Herbarium at Lund, Sweden.

TYPE LOCALITY: Not specifically designated, cited as "San Juan Island, on the piles of Friday Harbor's docks; Shaw Island and Canoe Island, dredged at a depth of 10-20 meters."

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9751. Bahía Blanca, 18-30 m.; D. 1574, D. 1613, near Punta María. Some of the latter specimens have dwarf laterals more than half as long as the long laterals and, with considerable suppression of the abaxial branchlets, give much the impression of *P. intermedium* Tokida.

#### A Working Key to the North Pacific Species of *Antithamnion*

- |   |    |
|---|----|
| 1. Primary determinate branches essentially in opposite pairs .....   | 2  |
| 1. Primary determinate branches in whorls of 3 or 4 .....   | 35 |
| 2. Some opposite pairs of determinate branchlets with one member commonly suppressed .....                        | 3  |
| 2. Determinate branchlets mostly in regular opposite pairs, rarely with suppression of one member of a pair ..... | 4  |
| 3. Plants slender and fragile, the main axes 60-75 $\mu$ in diam. ....  |    |
| ..... <i>A. gardneri</i> G. DeToni (this species is apparently equivalent to <i>A. spirographidis</i> Schiffner)  |    |
| 3. Plants relatively rigid, coarser, the main axis 125-140 $\mu$ in diameter .....                                |    |
| ..... <i>A. asymmetricum</i> Gardner  |    |
| 4. Determinate branches compound, that is, with secondary branchlets on one or both sides .....                   | 5  |
| 4. Determinate branches mainly simple, seldom with secondary branchlets on one or both sides .....                | 28 |
| 5. Secondary determinate branchlets predominately pectinate or secund .....                                       | 6  |
| 5. Secondary determinate branchlets predominately pinnate or forked .....   | 20 |
| 6. Gland cells present .....  | 7  |
| 6. Gland cells absent (or at least not reported) .....  | 14 |

- |     |  |    |
|-----|--|----|
| 7.  | A main indeterminate branch usually without an opposite determinate branch .....         | 8  |
| 7.  | A main indeterminate branch usually with an opposite determinate branch .....            | 11 |
| 8.  | Terminal cells of ultimate branchlets pointed .....                                      | 9  |
| 8.  | Terminal cells of ultimate branchlets rounded .....                                      | 10 |
| 9.  | Tetrasporangia sessile ..... <i>A. pygmaeum</i> Gardner                                  |    |
| 9.  | Tetrasporangia pedicellate ..... <i>A. setaceum</i> Gardner                              |    |
| 10. | Length of cells of main axes 2-3 times the breadth .....                                 |    |
|     | ..... <i>A. defectum</i> Kylin   |    |
| 10. | Length of cells of main axes 3.5-6 times the breadth .....                               |    |
|     | ..... <i>A. sparsum</i> Tokida   |    |
| 11. | Terminal cells always blunt, or at least not distinctly acute ....                       | 12 |
| 11. | Terminal cells distinctly acute .....  | 13 |
| 12. | Determinate lateral branches simple or with secund branchlets .....                      |    |
|     | ..... <i>A. miharai</i> Tokida (in part)   |    |
| 12. | Determinate lateral branches with pinnate branchlets ....                                |    |
|     | ..... <i>A. nipponicum</i> Yamada & Inagaki  |    |
| 13. | Gland cells resting laterally on 2-3 cells .... <i>A. kylinii</i> Gardner                |    |
| 13. | Gland cells resting on a single cell .....   |    |
|     | ..... <i>A. plumulum</i> (Ellis) Thur. var. <i>plumulum</i>                              |    |
| 14. | Terminal cells blunt .....   | 15 |
| 14. | Terminal cells pointed .....   | 18 |
| 15. | Plants over 1 cm tall, becoming corticated by lateral branchlets .....                   |    |
|     | ..... <i>A. corticatum</i> Tokida  |    |
| 15. | Plants under 1 cm in length (except <i>A. thouarsii</i> ), completely uncorticated ..... | 16 |
| 16. | Plants with erect, percurrent axes from a prostrate stolon .....                         |    |
|     | ..... <i>A. percurrans</i> Dawson  |    |
| 16. | Main axis of plant $\pm$ branched, not conspicuously percurrent .....                    | 17 |
| 17. | Primary lateral branches straight .....  |    |
|     | ..... <i>A. pteroton</i> (Schousb.) Born.  |    |
| 17. | Primary lateral branches adaxially curved .....  |    |
|     | ..... <i>A. thouarsii</i> (Mont) DeToni  |    |
| 18. | Tetrasporangia always pedicellate .....  |    |
|     | ..... <i>A. shimamuranum</i> Nagai   |    |
| 18. | Tetrasporangia sessile, or sometimes pedicellate .....                                   | 19 |
| 19. | Determinate branchlets mostly incurved .....   |    |
|     | ..... <i>A. alternans</i> Gardner  |    |
| 19. | Determinate branchlets mostly recurved .....   |    |
|     | ..... <i>A. secundatum</i> Gardner   |    |
| 20. | Gland cells present .....  | 21 |

20.	Gland cells absent .....	26
21.	Branch tips pointed .....	22
21.	Branch tips blunt .....	23
22.	Rhizoids multiple and compound from a node; gland cells on three cells .....	
	..... <i>A. cristirhizophorum</i> Tokida & Inaba	
22.	Rhizoids solitary and simple from a node; gland cells on two cells .....	
	..... <i>A. hubbsii</i> sp. nov.	
23.	Determinate lateral branches mostly simple in upper parts .....	
	..... <i>A. simulans</i> Gardner	
23.	Determinate lateral branches mostly branched in upper parts	24
24.	Determinate laterals with opposite branchlets .....	
	..... <i>A. pulchellum</i> Gardner	
24.	Determinate laterals alternately branched .....	25
25.	Indeterminate axes all creeping; determinate branches all ascending and dorsally erect from creeping axes .....	
	..... <i>A. lherminieri</i> (Cr. & Cr.) Nasr.	
25.	Some determinate axes free and erect; determinate branches essentially paired, opposite and bilateral at each node, but the pairs commonly spiraling .....	
	..... <i>A. sublittorale</i> Setch. & Gard.	
26.	Plants with a loose, pseudocortical band around lower nodes consisting of appressed, incurved and clasping secondary lateral branchlets .....	
	..... <i>A. pseudocorticatum</i> sp. nov.	
26.	Plants without any pseudocortication .....	27
27.	Tetrasporangia pedicellate; thallus reaching more than 5 cm high (sometimes up to 20 cm) and main axes over 80 $\mu$ in diameter .....	28
27.	Tetrasporangia sessile; thallus under 1 cm high, the main axis 30-40 $\mu$ in diameter .....	
	..... <i>A. palmyrense</i> Dawson	
28.	Branches recurved and causing entangling of the thallus parts to provide a rope-like appearance .....	
	..... <i>A. uncinatum</i> Gardner	
28.	Branches not recurved, without rope-like appearance ....	29
29.	Terminal cells of branchlets blunt .....	30
29.	Terminal cells of branchlets acute .....	33
30.	Tetrasporangia in pedicellate clusters from each bearing cell; basal cell of determinate laterals much shorter than others .....	
	..... <i>A. pacificum</i>	



30. Tetrasporangia solitary from each bearing cell; basal cell of determinate laterals about the same length as the others ..... 31
31. Plant about 2 mm high; tetrasporangia essentially confined to basalmost cell of determinate laterals .....  
..... *A. basisporum* Tokida & Inaba
31. Plants up to 1.5 cm high; tetrasporangia not confined to basalmost cell of determinate laterals (2-3 lower cells) ..... 32
32. Tetrasporangia tetrahedrally divided; gland cells sparse ..... *A. miharai* Tokida (in part)
32. Tetrasporangia cruciately divided, but often appearing as if tetrahedrally divided; gland cells frequent, often on adjacent cells, but sometimes apparently absent .....  
..... *A. glanduliferum* Kylin
33. Gland cells absent; tetrasporangia pedicellate .....  
..... *A. floccosum* (Müller) Kleen
33. Gland cells present ..... 34
34. Determinate branchlets 20  $\mu$  diameter; tetrasporangia sessile ..... *A. veleroae* Taylor
34. Determinate branchlets 80  $\mu$  diameter; tetrasporangia pedicellate ..... *A. dendroideum* Sm. & Hol.
35. Gland cells absent or unreported ..... 36
35. Gland cells present ..... 39
36. Thalli minute, less than 1 cm high ..... 37
36. Thalli macroscopic, 3-4 cm high .... *A. nigricans* Gardner
37. Determinate lateral branches in whorls of 4 .....  
..... *A. dumontii* Dawson
37. Determinate lateral branches in whorls of 3 (sometimes 4) .... 38
38. Tetrasporangia very large; plants 1-2 mm high, sparsely branched; Tongatabu ..... *A. graffei* (Grunow) DeToni
38. Tetrasporangia unknown; plants to 8 mm high, abundantly branched; Gulf of California .....  
..... *A. mcnabbii* Dawson
39. Terminal cells of lateral branchlets acute ..... 40
39. Terminal cells of lateral branches blunt ..... 43
40. Branchlets tapering abruptly at the tips ..... 41
40. Branchlets not tapering abruptly at the tips ..... 42
41. Successive verticils overlapping ..... *A. densiusculum* Gardner
41. Successive verticils not overlapping ..... *A. baylesiae* Gardner
42. Branchlets secund throughout, tapering to acute tips ....  
..... *A. subulatum* (Harv.) J. Ag.
42. Branchlets secund above, becoming pinnate below, subulate, with acute tips ..... *A. corallina* (Rupr) Kjellm.

43. Thallus minute, ranging from 1-2 mm in height; cells of main axes 40-50  $\mu$  in diameter ..... *A. breviramosus* Dawson
43. Thallus ranging from 0.5-8 cm in height; cells of main axes over 100  $\mu$  in diameter ..... 44
44. Gland cells on the terminal cells of lateral branches ....  
..... *A. terminale* Inagaki<sup>2</sup>
44. Gland cells lateral or basal on lateral branches and branchlets ..... 45
45. Basal cells of primary ramuli not giving rise to such filaments to long, cylindrical, slightly tapering, variously curved filaments ..... *A. similans* Gardner
45. Basal cells of primary ramuli not giving rise to such filaments ..... *A. occidentale* Kylin

***Antithamnion breviramosus* Daws.**

Pl. 5, fig. 3; Pl. 15, fig. 1

Dawson 1949, p. 14-15, fig. 28, 57; Dawson, 1954, p. 342; Dawson 1957a, p. 7; Dawson 1959, p. 28; Dawson 1960, p. 50.

Thallus minute, commonly epiphytic, consisting of a branched prostrate axis ca. 3-5 mm in extent attached at frequent intervals by simple, mostly unicellular rhizoids from the basal cell of determinate ramuli, the prostrate axes giving rise to erect axes 2-3 mm high; principal axes producing determinate branches in whorls of 3 from the distal end of the axial cells; axial cells 40-50  $\mu$  in diameter, 4-5 diameters long; determinate branches sometimes simple, commonly with 1-3 forkings, directed upward and adaxially curved, 10-15  $\mu$  in diameter, the cells mostly 2-3 diameters long, the basalmost cell shorter, the tips usually blunt, at least not sharply pointed; gland cells frequent on determinate branchlets, each arising from a single cell; reproduction unknown.

TYPE: Dawson 4920, March 24, 1948 in Herb. Allan Hancock Foundation 26521.

TYPE LOCALITY: Epiphytic on *Sargassum palmeri* in drift, Pebbly Beach, near Avalon, Santa Catalina Island, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 13301, Isla Magdalena, Belcher Pt., 12 m. *Gulf of Calif.*—D. 681, Puerto Libertad; D. 512, 1940, 1983, 3542, vicinity of Guaymas; D. 10964, Bahía Topolobampo. *Colima*—D. 21316, Bahía Santiago, 8 m.

COSTA RICA:—Hancock Exp. 465-35, 2/8/35, D. 10736, Playa Blanca. These are near *A. breviramosus* var. *simplex* Dawson (1957a, p. 117).

<sup>2</sup>The reduced nature of one opposite pair of the four verticillate branches from each node suggests that this species could equally well be placed in *Platythamnion*.

***Antithamnion dendroideum* Smith & Hollenb.**

Pl. 3, fig. 2-3; Pl. 5, fig. 1

Smith &amp; Hollenberg 1943, p. 217, fig. 20-21.

Thalli to 2 cm tall, with a percurrent axis bearing two or three major branches and with a simple branchlet opposite each major branch; cells in lower portion of axis 100-150  $\mu$  broad and with a length 3.5 times the breadth; basal cells of axis with long descending rhizoids; axis and branches with an opposite pair (very rarely a verticil of three) branchlets from the upper end of each cell; branchlets usually simple, 10-14 celled, and with the terminal three or four cells tapering abruptly to form an acute tip, occasionally with short pectinate branchlets from the adaxial side, these very short (2-4 celled) and with a gland cell, or longer and without; cells of branchlets up to 80  $\mu$  broad and with a length 2.5 times the breadth; tetrasporangia broadly elliptical, about 60  $\mu$  long, within a thick envelope, pedicellate and in small adaxial groups on the long lateral branchlets or on the occasional short secondary lateral branchlets; sexual plants not seen.

TYPE: G. M. Smith 41-525, in the Dudley Herbarium, Stanford University.

TYPE LOCALITY: On a rock fragment from a depth of 30-35 ft. about  $\frac{1}{4}$  mile northeast of the municipal pier, Monterey, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8298, Isla Guadalupe (60 m.).

***Antithamnion glanduliferum* Kylin**

Pl. 4, fig. 5-7

Kylin 1925, p. 47, fig. 28 E-G; Dawson, Neushul & Wildman 1960a, p. 24. *Antithamnion scrippsiana* Dawson 1949, p. 15, fig. 26, 27, 58.

Thalli 3-5 mm high (said to reach 5 cm), consisting of a group of erect, sparsely branched,  $\pm$  percurrent, distichous axes from a common, pad-like base; main axis 30-40  $\mu$  in diameter, of cells 1.5-2.0 diameters long, provided at each cell node with an opposite pair of determinate branchlets or an indeterminate branch opposite a determinate one (occasionally with a 3rd determinate branch at a node); determinate branches of 8-12 cells, ascending, usually simple, terminally somewhat blunt, of cells about as long as wide; gland cells apparently absent in the Mexican material (occasional to frequent in southern Californian and more northern material); tetrasporangia ellipsoidal to ovoidal, apparently tetrahedrally divided, about 40  $\mu$  long or more, adaxial and sessile on the lower 2-3 cells of the determinate laterals; spermatia borne in small, contiguous clusters on short, 2-3-celled spermatangia along nearly the whole adaxial surface of determinate laterals.

TYPE: A collection by Kylin without designation, probably in the Agardh Herbarium, Lund, Sweden.



TYPE LOCALITY: On old *Laminaria*, Friday Harbor Docks, San Juan Island, Washington.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 13234a, Islas Todos Santos, 40 m.; D. 20267 (Neushul), Sacramento Reef, 15-17 m.; D. 20396 (Neushul) Isla Asunción, 6-13 m.; D. 20353a (Neushul) Bahía San Hipólito, 8 m.

The Mexican specimens, although in agreement in general characters with this species are much smaller throughout than the type and have the main axial cells less elongated (1.5-2 diam. instead of 3-5 diam.). The apparent absence of gland cells seems enigmatic, but Dawson (1954) has pointed out that in some southern California collections gland cells may be abundant or sparse. Nevertheless, the lack of gland cells in the present materials calls for further study of additional collections of this plant and a comparison of the range of variability in this and other characters in conjunction with studies of the Japanese *A. miharai* Tokida, which is apparently exceedingly like, if not identical with *A. glanduliferum*. It was differentiated by Tokida on the basis of "paucity of gland cells" and the tetrahedral division of the sporangia. Smith (1944) has pointed out, however, that the tetrasporangia of *A. glanduliferum* are cruciate "but often appearing as if tetrahedrally divided." It seems probable that the Japanese and more northern Pacific coast plants are conspecific, but if it should be shown that the small, short-celled plant of southern California and Baja California, with sparse or absent gland cells, is actually distinct from the larger, northern examples, the application of the name *A. scrippsiana* Dawson will have to be considered once again.

*Antithamnion hubbsii* sp. nov.

Pl. 5, fig. 2; Pl. 6, fig. 3

Thalli epiphytici, plus minusve prostrati, axe primario per rhizoideum (interdum e fere omni cellula partis prostratae enascens) crebro affixo; rhizoideum multicellulare, uniseriatum c. 30-40  $\mu$  diam., in discum multicellularem desinens; axes primarii 50-60  $\mu$  diam., cellulis 4-5 plo longioribus quam latae, ramificatione sparsa indeterminata, omni cellula, autem, prope extremitatem distalem, par ramorum determinantum patentium aut quasi ascendentium habente; rami primarii determinati c. 1 mm. long. 30  $\mu$  diam. prope basim, e cellula basali subspherica enascentes, parte in basali ramulis oppositis pinnatis necnon parte in distali ramulis abaxiale secundis praediti, ramulis secundariis simplicibus aut ramellos nonnullos abaxiales habentibus; omnis ramulus attenuatus, admodum acutus, e cellulis 2.0-2.5 plo longioribus quam latae compositus; rami secundarii indeterminati axis primarii e cellulis basalibus subsphericis ramorum lateralium primarium determinantum enascentes; rhizoidea affixio e hac cellula basali quoque plerumque enascentia; glandicellulae sparsae, in ramis secundariis ramorum lateralium determinantum plerumque enascentes, in cellulis duabus sitae; reproductio ignota.

Thalli epiphytic, more or less prostrate, the primary axis attached

at frequent intervals (sometimes from nearly every cell of the prostrate part) by a multicellular uniseriate rhizoid about 30-40  $\mu$  in diameter terminating in an irregular multicellular disc; primary axes 50-60  $\mu$  in diameter, the cells 4-5 diameters long, with sparse indeterminate branching but provided near the distal end of each cell with a pair of spreading or somewhat ascending determinate branches; primary determinate branches about 1 mm long, 30  $\mu$  in diameter near the base, arising from a subspherical basal cell and provided with opposite pinnate branchlets in their basal part and abaxially secund branchlets in their distal part, the secondary branchlets simple or with a few abaxial branchlets; all branchlets attenuated, essentially acute, of cells 2.0-2.5 diameters long; secondary indeterminate branches of the primary axis arising from the subspherical basal cells of primary determinate laterals; attachment rhizoids also commonly arising from this cell; gland cells sparse, mostly on the secondary branches of the determinate laterals, lying on two cells; reproduction unknown.

TYPE: Holotype is E. Y. Dawson 8302, Dec. 19, 1949, in Herb. Allan Hancock Foundation.

TYPE LOCALITY: On *Codium* from a depth of 70 m., Melpomene Cove, Isla Guadalupe, Baja Calif., Mexico. Additional material: D. 8311; D. 19295, 19297 (Carl Hubbs) dredged, Isla Guadalupe.

This species is closely related to *A. cristirhizophorum* Tokida and Inaba (1950). It differs mainly in the characters of the rhizoids which are solitary from a node in the present species, rather than multiple and compound. The determinate branches tend to be more attenuated and to have longer cells. The gland cells usually adjoin two rather than three cells.

### *Antithamnion kylinii* Gard.

Pl. 6, fig. 1

Gardner 1927b, p. 411, pl. 89, fig. 1; Dawson 1954, p. 342.

Thallus densely tufted, 2-3 (4) cm high, usually with a central percurrent axis bearing several major branches; all branches giving rise from near the distal end of each cell to paired, opposite, determinate branches with 5-8 secund ultimate branchlets on the adaxial side; indeterminate branches usually with an opposite simple determinate branch; cells of main axes (80) 125-150 (170)  $\mu$  in diameter below and about 3 diameters long, cylindrical; determinate branchlets 12-15 cells long, tapering very gradually to acute apices, the basal cell being subspherical, the others cylindrical to slightly dolioform; gland cells on the ultimate branchlets, usually lying on two cells; tetrasporangia usually on 1-celled pedicels, 1-3 on the adaxial side of the geminate branchlets near the base, 40-70  $\mu$  long; sexual plants unknown (modified after Gardner).

TYPE: Gardner 3904, June, in the Herbarium of the Univ. of



California, Berkeley (284038). An isotype fragment is in Herb. A. Hancock Foundation.

TYPE LOCALITY: Growing on log floats in the harbor at Victoria, Vancouver Island, Canada.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 103, Cabo Colnett; D. 8789, Bahía San Quintín; D. 1577, Punta María; D. 9757, Bahía Blanca, 18-30 m.; D. 35-40, 13426, Bahía Santa María, Isla Magdalena.

This Mexican material corresponds closely with Gardner's original description except that in some of it a greater attenuation of the branchlets is evident, due, perhaps, to the local environmental conditions.

### ***Antithamnion lherminieri* (Cr. & Cr.) Nasr**

Pl. 5, fig. 5

Nasr 1941, p. 66, fig. 9-10; Dawson 1956, p. 53, fig. 51. *Callithamnion lherminieri* Crouan & Crouan, in Maze & Schramm 1870-77, p. 144. *Antithamnion antillanum* Børgesen 1915-20, p. 226, fig. 213-216.

Thalli minute, epiphytic, consisting of a creeping axis producing erect branches about 1 mm high; creeping axes 30-70  $\mu$  in diameter, of cells about 4 diameters long, with sparse indeterminate branching, producing from each cell an opposite pair of ascending, determinate, compound branches, attached by short, pluricellular rhizoids with discoid tips arising, usually singly, from the basal cells of the more ventral of each opposite pair of branches; determinate branches of cells 10-15  $\mu$  in diameter, 1.3-3 diameters long, alternately branched from nearly every cell, the tips blunt; gland cells lying next to two cells on ultimate branchlets; reproduction not observed in Mexican material.

TYPE: A Maze & Schramm collection no. 1259 on "*Galaxaura umbellata*", probably to be found in Herb. Crouan at the marine botanical station, Concarneau, France.

TYPE LOCALITY: Guadeloupe, West Indies.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 35a-40, on a decaying algal fragment, Bahía Santa María, Isla Magdalena, 20 m. *Gulf of Calif.*—D. 3095, 3166, on algal fragments in drift, 5 km. N. of Cabo Pulmo.

### ***Antithamnion mcnabbii* Daws.**

Pl. 5, fig. 4

Dawson, 1959, p. 28, fig. 7.

Thalli minute, abundantly branched and densely aggregated, to 8 mm tall, forming soft, red tufts on short articulated corallines on rock surfaces, consisting of interwoven, branched monosiphonous, ecorticate axes about 25  $\mu$  in diameter below, bearing numerous, generally simple, multicellular rhizoids, each arising from the basal cell of a determinate lateral branch; axial cells about 150  $\mu$  long below, 100  $\mu$  above and

gradually reduced to the tips; secondary indeterminate branches frequent, 3-4 segments apart, multifarious, usually without tertiary intermediate branches; ultimate determinate branchlets whorled in groups of three, short, about  $100\ \mu$  long, with two, three, or sometimes four forks in a digitate manner, the first two usually of a single cell each and the last sometimes of a single cell, sometimes of two, the cells successively reduced in size to  $10\ \mu$  or less long and  $6-7\ \mu$  wide at the ends, the end of the cell blunt, subacute, or bearing a colorless hair; gland cells absent; reproduction not seen.

TYPE: Dawson 18855, April 20, 1958, in Herb. Los Angeles County Museum.

TYPE LOCALITY: Scraped from rock surfaces with other minute algae from depths of about 3 feet, El Solitario rock, Bahía Agua Verde, Baja California del Sur, Mexico.

In size and superficial characters this tiny species suggests *A. breviramosus* Dawson. The dense aggregation of axes matted together with rhizoids, the absence of gland cells and the short-segmented, digitate determinate laterals are, however, amply distinctive.

***Antithamnion pacificum* (Harv.) Kylin**

Pl. 4, fig. 8-9

Kylin, 1925, p. 47. fig. 29; Dawson, 1944, p. 313; Smith 1944, p. 310. *Callithamnion flocossum* var. *pacificum* Harvey 1862. p. 176.

This species was reported by Dawson as occurring at Tepoca Bay, upper Gulf of California, at a depth of 22 meters, and near Guaymas at 30-36 meters. These specimens do not now appear in the Allan Hancock Foundation Herbarium and are presumed misfiled. The verification of this occurrence must await further collections.

***Antithamnion plumulum* (Ellis & Solander) Thuret, ex LeJolis  
var. *plumulum***

Pl. 6, fig. 4

Thuret, in LeJolis 1863, p. 112; Okamura 1922, pl. 189, p. 157. *Conserva plumula* Ellis and Solander 1786, pl. 57, p. 426; Dillwyn 1809, pl. 50.

Thalli minute, 1-3 mm or more in extent, consisting of a primary axis  $40-50\ \mu$  in diameter; cells 1-1.5 diameters long below to 2 diameters long above; indeterminate branches of the axis with an opposite determinate branch; axes provided at each cell node with an opposite pair of determinate branches  $200-300\ \mu$  long of 6-9 elongated cells, at first incurved, later somewhat recurved, bearing on their adaxial side 3-5 simple, somewhat attenuated, acute, ultimate branchlets; main axes producing here and there 1 or a pair of short, spine-like determinate branchlets in a plane perpendicular to the regular distichous laterals; gland cells on ultimate branchlets, resting on a single cell; reproduction not observed.

TYPE: A collection by Ellis, probably to be found in the Dillwyn Herbarium in the Linnaean Society Herbarium, in Herb. Kew, or Herb. Dept. of Botany, Oxford.

TYPE LOCALITY: Brighton, England.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8267, Isla Guadalupe, 55-84 m.

This material in which dwarf laterals do occur, but irregularly and infrequently, provides an instance in which the merging of *Antithamnion* and *Platythamnion* may be observed. See remarks under *Platythamnion* and *P. pectinatum*, which is probably closely related if not conspecific with this collection.

***Antithamnion pseudocorticatum* sp. nov.**

Pl. 7, fig. 1-5

Thallus minutus 1-5 mm. altus, ex axibus indeterminatis prostratis 100-120  $\mu$  diam., e cellulis 270-300  $\mu$  long. compositis, constans. Thallus ramosus indeterminatos erectos, per rhizoidea multicellularia longa attenuata 10-12  $\mu$  diam. c. 100  $\mu$  long. unum ad aliquot e nodo affixos, efficiens; rami indeterminati erecti e cellulis 20-30  $\mu$  diam., 2-3 plo longioribus quam latae compositi, distichi, ramificationem indeterminatam secundariam alternatam, intervallis 3-10 cellularum, praebentes, omni cellula ex extremitate distali par oppositum ramorum ferente; rami determinati laterales e 6-12 cellulis constantes, cellulis 5-10  $\mu$  diam., infimis sphericis, aliis ca. 1.5-2 plo longioribus quam latae, paululum incurvatis, ex omni cellula nisi ultimis 1-3 regulariter pinnati, his pinnis partim ramulos breves habentibus, cacuminibus ramulorum admodum obtusis; cellula basalis rami lateralis determinati par adaxiale ramulorum, brevium compositorum atque ramulum unicum abaxiale primum ferens his ramulis aliquamdiu meristematicis, progredienter ramosis, incurvatis, plus minusve appressis, factis, involucrium laxum nodale formantibus, parte distali rami lateralis determinati originalis postremo decidua; glandicellulae nullae; reproductio ignota.

Thallus minute, 1-5 mm high, consisting of prostrate indeterminate axes 100-120  $\mu$  in diameter of cells 270-300  $\mu$  long, producing erect, indeterminate branches attached by long, attenuated multicellular rhizoids 10-12  $\mu$  in diameter, 1-several from a node, ca. 100  $\mu$  in length; erect indeterminate branches of cells 20-30  $\mu$  in diameter, 2-3 diameters long, distichous, with alternate secondary indeterminate branching at intervals of 3-10 cells, all cells bearing an opposite pair of branches from their distal end; determinate lateral branches consisting of 6-12 cells 5-10  $\mu$  in diameter, the lowermost spherical, the others about 1.5-2 diameters long, slightly incurved, regularly pinnate from each cell except the last 1-3, these pinnae in part with short branchlets, the branchlet tips essentially blunt; basal cell of a determinate lateral at first bearing an adaxial pair of short, compound branchlets and a single abaxial one, these remaining meristematic for some time, branching progressively and becoming incurved, more or less appressed, and forming a loose nodal envelopment, the distal part of the original



determinate lateral ultimately deciduous; gland cells absent; reproduction unknown.

TYPE: Holotype is E. Y. Dawson 6934b, March 15, 1949, in Herb. Allan Hancock Foundation.

TYPE LOCALITY: San Lorenzo Channel, Baja California, dredged from 8-20 m.

The tendency of the secondary branchlets from the subspherical basal cell of the primary determinate branches to grow around the indeterminate axis like a loose cortication distinguishes this species from all known species of *Antithamnion* and is suggestive of the more profusely compacted cortication of *A. cladodermum* (Zan.) J. Ag. (see Funk, 1955, p. 110, fig. 4, 5, 6). The only other corticated species of *Antithamnion* known is *A. corticatum* Tokida (1932, p. 109, pl. III), and in this one only a few ultimate laterals grow parallel and appressed to the indeterminate axis. The close, symmetrical, distichous branching is also distinctive.

### *Antithamnion pygmaeum* Gard.

Pl. 6, fig. 2

Gardner 1927b, p. 413, pl. 91, 92, 93; Dawson 1949, p. 26; Dawson, Neushul & Wildman 1960a, p. 24 (partly as *A. kylinii*)

Thalli minute, fragile, 4-7 mm high, attached by a branched discoid base, in part prostrate and attached by compound rhizoids 3-4 cells long arising from the basal cell of a branch and becoming discoid at their distal ends; main axes percurrent, sparingly branched, 50-75  $\mu$  in diameter at the base, tapering very gradually to the apices; main axes and branches clothed with paired, opposite, determinate ramuli from every cell, but without such a ramulus opposite an indeterminate main branch; determinate ramuli, becoming more or less recurved, composed of 6-10 cylindrical cells 24-28  $\mu$  in diameter, 2-2.5 diameters long, except the subspherical basal one, giving rise adaxially to 6-8 second, somewhat outwardly curved, ultimate ramuli; subspherical basal cell often bearing a diminutive indeterminate branch; tetrasporangia ellipsoidal, 75-80  $\mu$  long, terminal or lateral and sessile (sometimes apparently pedicellate) on short adaxial ultimate branchlets; spermatangia forming cylindrical clusters on the adaxial side of the ultimate ramuli; gland cells present on the ultimate ramuli, commonly near the tips and lying along 2 cells.

TYPE: Gardner 5090, July, in the Herbarium of the University of California, Berkeley (296663). An isotype is in Herb. A. Hancock Found.

TYPE LOCALITY: Epiphytic on the stipe of *Pelagophycus porra*, La Jolla, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8006, Cortez Bank, 30-40 m.; D. 4266, Isla Coronado del Sur; D. 20480 (Neushul),



Bahía Vizcaino, 37 m.; D. 20353 (Neushul), Bahía San Hipólito, 8 m. A single dried collection from the northern Gulf of California, D. 185-40, seems to be this species but is too poorly preserved for positive identification.

The frequent occurrence from the basal cells of determinate geminate ramuli of indeterminate branches of delayed or suspended development is a character of probable significance in this species.

Most of the Mexican specimens lack tetrasporangia and cannot positively be distinguished from *Antithamnion setaceum* Gard.

***Antithamnion secundatum* Gard.**

Pl. 7, fig. 3

Gardner, 1927 b, p. 413.

Thalli minute, 7-8 mm in extent, the lower parts, or sometimes major parts of plant, prostrate and attached by slender, multicellular rhizoids; primary axes about 60  $\mu$  in diameter, of cells 1.5-2.0 diameters long, frequently branched, the indeterminate branches without an opposite ramulus, all axes otherwise clothed with paired, opposite, determinate ramuli from the distal end of each axial cell; determinate lateral branchlets 20-22  $\mu$  in diameter at the base, about 40  $\mu$  long, of 8-10 cells, the basal cell subspherical, the others about 2 diameters long, somewhat attenuated, the tips pointed, the outer ends more or less recurved, especially in age, bearing adaxially 4-6 simple, outwardly curved ultimate branchlets; basal cell often producing indeterminate branches; gland cells absent; reproduction not seen in Mexican material; tetrasporangia described as: "either on short (1-2 cells), diminutive, fructiferous ramuli arising on the adaxial side and on the lower half of the geminate ramuli, the upper half being occupied by the ultimate ramuli, or sessile on the same and frequently on the same cell with an ultimate ramulus, or sessile on the adaxial side of the ultimate ramuli, 75-85  $\mu$  long, 60-64  $\mu$  broad;" carpogonia, cystocarps and antheridia unknown.

TYPE: Gardner no. 3525, December, in Herb. University of California, Berkeley (296617). An isotype is in Herb. A. Hancock Foundation.

TYPE LOCALITY: Growing on floats in the harbor of San Diego, California.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—A. H. F. St. 554-36 (D. 4367), March 8, 1936, Isla Ángel de la Guarda, 20 m.; D. 6934a, Canal de San Lorenzo, 14-26 m.

***Antithamnion sublittorale* Setch. & Gard.**

Pl. 7, fig. 2

Setchell and Gardner, 1937, p. 86, pl. 6, fig. 15; Dawson, 1944, p. 313.

Thallus minute, consisting of a sparingly branched creeping axis

and frequent, semi-erect, indeterminate axes 6-10 mm high; primary axes 55-65  $\mu$  in diameter, bearing paired, opposite distichous branches, (sometimes with an additional third branch), and a determinate branch always opposite an indeterminate branch; paired determinate branches spiraling, not distichous; cells in main axis 3-4 times as long as broad; determinate lateral branches mostly 200-300  $\mu$  long, somewhat attenuated, usually incurved, the terminal cells blunt to acute, simple or 1-3 times forked beginning with the 3rd cell, the cells 10-15  $\mu$  in diameter, 1.5-2 diameters long, but the basalmost shorter; gland cells frequent, scattered, much smaller than the single bearing cell; gominoblast consisting of a 3 or 4-lobed cluster 240  $\mu$  long, from the basal cell of a determinate lateral; spermatia on short (12-15  $\mu$ ) spermatangia; tetrasporangia 1 or 2, adaxial, sessile, on the 1st or 2nd cell of a determinate lateral.

TYPE: J. T. Howell 613, Aug. 4, 1932, in Herb. California Academy of Sciences (236524).

TYPE LOCALITY: Epiphytic, at a depth of 37 m., San Jose del Cabo, Baja Calif., Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 6983, Bahía Salinas, Isla Carmén, 4-30 m.; D. 6906, 6914, 6934, Canal de San Lorenzo, Isla Espíritu Santo, 8-20 m.; D. 6731, 6744, Punta Frailes, 8-16 m.; Howell 646a, 721, San Jose del Cabo, 40 m.

It is evident from an examination of these specimens and those of *A. breviramosus* Dawson that the two species are closely related. The latter have determinate branches regularly in whorls of three while the former are predominately pinnate. However, several of the specimens of *A. sublittorale* show an occasional 3rd branch at a node. In size, habit and other vegetative characters, they are similar. Fertile material has been found in most of the collections of *A. sublittorale*, but none has appeared in the more numerous collections of *A. breviramosus*. The latter is known from a number of intertidal or shallow water collections, while all *A. sublittorale* materials are from sublittoral habitats.

### *Crouania attenuata* (C. Ag.) J. Ag.

Pl. 7, fig. 4

J. Agardh 1842, p. 83; Dawson 1957a, p. 7; Dawson 1952, p. 431; Setchell & Gardner 1930, p. 167. *Mesogloia attenuata* C. Agardh 1824, p. 51. *Batrachospermum attenuatum* Bonnemaison, (nom. nud.) in C. Agardh 1824, p. 51.

Thalli epiphytic or saxicolous, little-branched or tufted, 1-3 (5) cm. high, attached by rhizoids, the main thallus parts cylindrical and somewhat terminally attenuated,  $\pm$  mucilaginous, consisting of a cylindrical, axial, non-corticated cell row about 200  $\mu$  in diameter near the base, more slender above, of cells 1-3 (4) diameters long, each giving rise near the distal end to a whorl of usually 4 compound determinate

branches; basal cell of determinate branches obovoid, provided with 3-4 branchlets, in turn with 2-3 orders of dichotomous or trichotomous branchlets successively narrowed and elongated, sometimes to a hair, or short and blunt; tetrasporangia subspherical, cruciate, 50-60  $\mu$  in diameter, sessile on the basal cell of determinate branches; spermatia arising in groups of 2-3 from the terminal cells of the determinate lateral branches; four-celled carpogonial branches borne on short, fertile lateral branches often reduced to a single cell; gonimoblast with 2-3 gonimolobes.

TYPE: A collection by Bonnemaison, possibly to be found in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: "Atlantic Ocean". Probably the Atlantic coast of France.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 4091 (Hubbs) 18-30 m., D. 8230, 6-18 m., D. 8438, 8440, 47-55 m., Mason 127 (cast), D. 19235 (Limbaugh & Church), 19-26 m., Isla Guadalupe; D. 10439, 12 mi. east of Punta Eugenio, intertidal; D. 16172 (Limbaugh), Rocas Alijos, 8-28 m. (Herb. LACM). *Revillagigedo Arch.*—D. 4363 (A.H.F. Sta. 135-34), Jan. 5, 1934, Bahía Sulphur, Isla Clarión, 47 m.

Two forms occur among these collections, one in which the verticils of lateral branches are very dense and approximate, the other in which the axial cells are more elongate and the verticils distinctly separated. In the former the branchlets show an ascending character and the cells become quite narrow, often ending in a hair as in European material illustrated by Feldmann-Mazoyer. In the latter the ascending character of the branchlets is not much evident, the branchlets are more rigid, shorter celled and divaricate, more like the Japanese material illustrated by Okamura (1926, pl. 235). Since both forms have been found in the Guadalupe Island collections it is assumed that they represent environmental variations of this widespread tropical and subtropical species known from warm waters of both the north Atlantic and north Pacific and from intertidal localities down to 55 meters.

#### A Working Key to the North Pacific Species of *Callithamnion*

- |  |   |
|--|---|
| 1. Thalli with basal endophytic filaments; erect filaments to 2 mm. high .....   | 2 |
| 1. Plants not endophytic, mostly 2 mm. high or more .....                        | 3 |
| 2. Endophytic on fleshy algae; filaments 7-12 $\mu$ in diameter .....            |   |
| ..... <i>C. endovagum</i> Setch. & Gard.   |   |
| 2. Endophytic on articulated corallines; filaments 20-40 $\mu$ in diameter ..... |   |
| ..... <i>C. lejolisea</i> Farlow   |   |
| 3. Plants $\pm$ prominently corticated .....                                     | 4 |
| 3. Plants ecorticate, or with but a few descending filaments near the base ..... | 8 |

4. Cells mostly 3-4 (5) diameters long above .....  
..... *C. squarrulosum* Harvey
4. Cells mostly 1-2 diameters long above ..... 5
5. Cortication confined to lower parts; ultimate branches short,  
of 1-3 (4) cells ..... *C. breviramisum* Gardner
5. Cortication extensive; ultimate branches longer, of more than  
five cells ..... 6
6. Ultimate branches recurved and widely spreading .....  
..... *C. laxum* Gardner
6. Ultimate branches incurved ..... 7
7. Terminal cell of branchlets 2-4 toothed .... *C. pikeanum* Harvey
7. Terminal cell of branchlets acute or blunt, not toothed .....  
..... *C. arborescens* Gardner
8. Asexual sporangia once divided into bispores .....  
..... *C. bisporum* Gardner
8. Asexual sporangia twice divided into tetrasporangia ..... 9
9. Tips of ultimate branchlets pointed or aculeate (Note: some-  
times acute in *C. soccoriense*) ..... 10
9. Tips of ultimate branchlets blunt, or at least not pointed or  
aculeate ..... 13
10. Ultimate branchlets attenuated to acute tips (The type of  
*C. californicum* Gardner (1927) seems to be identical  
with this) ..... *C. acutum* Kylin
10. Ultimate branchlets sharply reduced at the tip to a conical  
or aculeate terminal cell ..... 11
11. Branching alternate throughout ..... 12
11. Upper branchlets in second, adaxial series of 2-4 from the base  
of bearing branch ..... *C. catalinae* sp. nov.
12. Plants 1-2 cm. tall; main axes to 150  $\mu$  in diameter;  
tetrasporangia subspherical, 50-60  $\mu$  in diameter .....  
..... *C. ecuadoreanum* Taylor
12. Plants 2-7 cm. tall; main axes 110-150  $\mu$  in diameter;  
tetrasporangia about 48  $\mu$  in diameter, 55  $\mu$  long .....  
..... *C. soccoriense* Taylor (in part)
13. Branching dominantly distichous in middle and upper parts  
or tending to be distichous rather than multifarious ..... 13
13. Branching dominantly multifarious (spiral or radial) through-  
out ..... 20
14. Gland cells prominent ..... *C. callophyllidicola* Yamada
14. Gland cells absent or unreported ("sparse" in *C. ramosi-  
ssimum*) ..... 15



15. Ultimate branchlets becoming prominently recurved in age .... 16
15. Ultimate branchlets remaining  $\pm$  incurved throughout ..... 17
16. Lateral branchlets at first overarching, forcipate, later recurved and uncinatate ..... *C. uncinatum* sp. nov.
16. Lateral branchlets only incurved at first, not forcipate, later recurved but not uncinatate .. *C. rupicolum* Anderson
17. Tetrasporangia sessile and solitary ..... 18
17. Tetrasporangia multiple and pedicellate .... *C. biserialatum* Kylin
18. Ultimate branchlets 15-20  $\mu$  in diam. .... *C. paschale* Børgesen (The Japanese *C. minutissima* Yamada is similar and possible conspecific)
18. Ultimate branchlets (40) 50-65  $\mu$  in diameter ..... 19
19. Cells of lower main axes about as long as broad ..... *C. pacificum* Taylor
19. Cells of lower main axes 3.5 diameters long ..... *C. soccoriense* Taylor (in part) (Variation in this species makes distinction from *C. pacificum* uncertain)
20. Ultimate branchlets short, of 1-4 cells, commonly ending in a deciduous hair ..... *C. corymbosum*
20. Ultimate branchlets longer, of 5 or more cells, without terminal hairs ..... 21
21. Ultimate branchlets relatively coarse, about one half the diameter of the main axes, or more ..... 22
21. Ultimate branchlets slender, 1/3 to 1/10 the diameter of the main axes ..... 23
22. Plants 1-2 mm tall, of compact form, arising from a multicellular disc ..... *C. compactum* sp. nov.
22. Plants about 1 cm. tall, of loose form, attached by rhizoids ..... *C. rigidum* sp. nov.
23. Plants much attenuated from the base (170-300  $\mu$ ) to the tips (8-10  $\mu$ ), abundantly and densely branched above ..... *C. ramosissimum* Gardner
23. Plants not so much attenuated, the ultimate branchlets about  $\frac{1}{4}$  the diameter of the axes, more or less openly branched above ..... 24
24. Lateral branchlets ascending, 30-20  $\mu$  in diameter ..... *C. marshallense* Dawson
24. Lateral branchlets divaricate, attenuated from 15-10 to 8-4.5  $\mu$  in diameter ..... *C. epiphyticum* Taylor

***Callithamnion bisporum* var. *australe* var. nov.**

Pl. 9, fig. 4

Thalli c. 1 cm. alt., ex axibus paucis ramosis, per rhizoidea multicellularia affixis, constantes; axes erecti non-percurrentes ecorticati, ad basim ad 200  $\mu$

diam., e cellulis 1.2-1.5 longioribus quam latae constantes, in 4 ordines ramosi, ad ramos ultimos 10-15  $\mu$  diam. per longitudinem gradatim attenuati; ramificatio e parte superiore cellularum successivarum alterna, saepius spiralis infra, distichia supra, partibus mediis per 8-12 cellulas saepe sine ramis; cellulae partium mediarum 4-6 plo longiores, supra 3-5 plo longiores quam latae, rami ultimi e 4-8 cellulis constantes, extrema in parte obtusi, aliquantulum adaxialiter curvati; glandicellulae nullae; sporangia asexualia semel divisa ad bisporas formandas, bisporis adaxialibus, serialibus interdum duabus ex una cellula formatis, sessilibus, ellipticis, 50  $\mu$  long., 30  $\mu$  diam.; plantae sexuales non visae.

Thalli about 1 cm tall, consisting of a few branched axes attached by multicellular rhizoids; erect axes non-percurrent, ecorticate, to 200  $\mu$  in diameter at the base, of cells 1.2-1.5 diameters long, branched in four orders, gradually attenuated throughout to the ultimate branches 10-15  $\mu$  in diameter; branching alternate from the top of successive cells, tending to be spiral below, distichous above, the mid-parts often barren of branches for 8-12 cells; cells in mid-parts 4-6 diameters long, 3-5 diameters long above; ultimate branches of 4-8 or more cells, terminally blunt, somewhat adaxially curved; gland cells absent; asexual sporangia once divided to form bispores, these adaxial, serial, sometimes 2 from a cell, sessile, elliptical, 50  $\mu$  long, 30  $\mu$  in diameter; sexual material not seen.

TYPE: Holotype is E. Y. Dawson 7190, March 18, 1949, in Herb. A. Hancock Foundation. An isotype slide is in Herb. Beaudette Foundation.

TYPE LOCALITY: Dredged in 6-9 m., outer bay Puerto Escondido, Gulf of California, Mexico.

*C. bisporum* Gardner has been reported only from the type locality in Puget Sound, Washington. This collection from a remote locality in Mexico provides a strikingly disjunct distribution and has called for a varietal distinction which is found largely in the longer ultimate branchlets and smaller bisporangia.

### ***Callithamnion breviramsum* Gard.**

Pl. 8, fig. 3-4

Gardner, 1927 b, p. 403, pl. 84. *Callithamnion varispiralis* Dawson, 1949, p. 16, fig. 29, 30, 54.

Thalli epiphytic, 7-12 mm high, consisting of a tuft of principal axes from a common fleshy, somewhat pulvinate base composed in part of a mass of multicellular, branched rhizoids; erect axes 140-170  $\mu$  in diameter in lower parts, the cells about as long as broad, becoming distinctly corticated by closely appressed descending filaments from the basal cells of lateral branches, later becoming obscured, in part, by loose entangling rhizoids; main axes densely clothed with short, rigid branchlets of mostly five orders arising spirally from each axial cell, these of cells about 1.5 diameters long, somewhat assurgent, the ultimate

branchlets usually of 1-3 cells, 9-12  $\mu$  in diam., blunt tipped; tetrasporangia sessil, subspherical, 50-65  $\mu$  in diam., usually solitary on the outer limbs of lateral branchlets; spermatangia born on the adaxial side of ramuli in small tufts 25-35  $\mu$  in diameter (Gardner says "covering" and does not mention "small tufts"); cystocarps relatively abundant, mostly paired, irregular in form, much elongated in the juvenile stage, enclosed in a thick hyaline membrane; carpospores large, subspherical.

TYPE: N. L. Gardner 5035, June, in Herb. University of Calif., Berkeley (296620).

TYPE LOCALITY: Growing on *Phyllospadix*, La Jolla, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8481, 8566, Isla Guadalupe, intertidal; D. 10429, Bahía de Todos Santos, drift; D. 10310, 10 mi. west of Punta Malarrímo, Bahía Vizcaino.

### *Callithamnion catalinense* sp. nov.

Pl. 9, fig. 1-2

Thalli ad 14 mm. alt., partibus basalibus imperfectis, ut videtur, autem, per aliquot rhizoidea multicellularia ramosa, e cellulis inferioribus axis principalis nata, affixi; ramificatio vel 2 vel 3 ordinum; axes principales ad 180  $\mu$  diam. e cellulis infra 3.0-3.5 plo longioribus quam latae, supra 2.0-2.5 compositi, irregulariter alterne aut partim unilateraliter, admodum eodem in plano ramosi, cellulis inferioribus axium principalium partim sine ramis; rami ultimi in serie adaxiali secunda bini ad quaternos e cellulis inferioribus rami ferentis orientes, deinde usque ad extremitatem rami ferentis alterne dispositi, e 2-20 cellulis compositi, 1-2 mm. long. ascendentes et incurvati, cellulis ca. aequae longis ac latis, interdum brevioribus quam latae, cellulis 4-5 ultimis ad cacumen terminale reductis; tetrasporangia multa, secundum longitudinem totam ramorum ultimorum necnon interdum penultimorum seriatim adaxialiter nata, elliptica, 50-60  $\mu$  long, sessilia singula aut plura e quaque cellula progredienter evolvenda; plantae sexuales non visae.

Thalli to 14 mm. tall, the basal parts incomplete, but apparently attached by several multicellular, branched rhizoids from the lower cells of the main axes, the branching of 2-3 orders; principal axes to 180  $\mu$  in diam. of cells 3.0-3.5 diameters long below, 2.0-2.5 diameters above, irregularly alternately or in part unilaterally branched, essentially in one plane, lower cells of principal axes partially without branches; ultimate branches arising in an adaxial, second series of 2-4 from the lower cells of the bearing branch, then alternate to the end of the bearing branch, of 2-20 cells, 1-2 mm. long, ascending and incurved, the cells about as long as broad, sometimes shorter than broad, the last 4-5 cells reduced to a terminal point; tetrasporangia abundant, borne serially and adaxially along the entire length of the ultimate and sometimes penultimate branches, elliptical, 50-60  $\mu$  long, sessile, solitary, or commonly more than 1 developing progressively from each cell; sexual plants not seen.

TYPE: Holotype is E. Y. Dawson 8096, Sept. 7, 1949, in Herb. Allan Hancock Foundation.



TYPE LOCALITY: Dredged in 15-30 m., Farnsworth Bank, Santa Catalina Island, California.

This species has not yet been detected in Mexico, but almost certainly it will be found there when sublittoral areas similar to Farnsworth Bank are more extensively explored.

***Callithamnion compactum* sp. nov.**

Pl. 9, fig. 3

Thalli epiphytici penicilla compacta rotundata 1-2 mm. alt. formantes, ex axibus brevibus congestis, e disco communi multicellulari orientibus, constantes; axes erecti ecorticati ad basim  $30\ \mu$  diam., supra diametro, nisi ad cacumina, vix reducti cellulis 1.2-2.0 plo longioribus quam latae; axes principales ramos unum vel aliquot primarios breves habentes, omnes ramulis obtusis incurvatis plerumque simplicibus (aut semel furcatis)  $150-200\ \mu$  long.,  $20-25\ \mu$  diam. vestiti; ramuli e cellulis aliquantulum longioribus quam latae compositi, alterni (interdum oppositi), spiraliter ordinati; glandicellulae nullae; tetrasporangia multa, seriata (4-6) sessilia in ramulis adaxialia ca.  $35\ \mu$  long.,  $30\ \mu$  lat; reproductio sexualis ignota.

Thalli epiphytic, forming compact, rounded tufts 1-2 mm. high, consisting of densely congested short axes from a common multicellular disc; erect axes ecorticate,  $30\ \mu$  in diameter at the base, scarcely reduced in diameter above except at the tips, the cells 1.2-2.0 diameters long; main axes with one or a few short primary branches, the whole clothed with mostly simple (or once forked) incurved, blunt ramuli  $150-200\ \mu$  long,  $20-25\ \mu$  in diam., of cells a little longer than broad; ramuli alternate (occasionally opposite) spirally arranged; gland cells absent; tetrasporangia abundant, seriate (4-6), sessile, adaxial on the ramuli, about  $35\ \mu$  long,  $30\ \mu$  broad; sexual reproduction unknown.

TYPE: Holotype is E. Y. Dawson 9179, April 28, 1950, in Herb. A. Hancock Foundation. An isotype slide is in Herb. Beaudette Foundation.

TYPE LOCALITY: Epiphytic on *Prionitis delicatula*, intertidal, Bahía Asunción, Baja California, Mexico.

ADDITIONAL MATERIAL: D. 13419, on the same host, intertidal, Pacific Isla Magdalena, Baja California, Mexico. A sterile plant of similar characters, possibly referable here, is D. 3499, vicinity of Guaymas, Sonora, Mexico, epiphytic on *Grateloupia*.

The compact habit of numerous axes from a spreading disc is distinctive as well as the subsimple, spiral, incurved, blunt ramuli.

***Callithamnion endovagum* Setch. & Gard.**

Pl. 8, fig. 5

Setchell & Gardner 1924, p. 771, pl. 28, fig. 62; Dawson 1953, p. 19. *Acrochaetium grateloupiae* Dawson 1950, p. 1953, fig. 22-23.

Thalli partly endophytic, the endophytic filaments intercellular, growing between the cortical cells and parallel to the surface of the host, 7-11.5  $\mu$  in diam.; erect portions 4-12 cells long, to  $250\ \mu$  high, with



one or two orders of alternate branches, the cells 7-12  $\mu$  in diam. and mostly about 3 diameters long, the upper branches more slender and the cells longer, the tips blunt; tetrasporangia tetrahedrally divided, ovoid, lateral (or rarely terminal), sessile on the erect filaments, 20-23  $\mu$  wide, 23-28  $\mu$  long; cystocarps small, apparently with but a single lobe, commonly arising from the second or third cell of a main external axis; spermatangial plants not seen.

TYPE: Ivan M. Johnston no. 53b, April, in Herb. California Academy of Sciences, San Francisco (1363).

TYPE LOCALITY: Growing in the fronds of *Grateloupia prolongata*, Isla San Esteban, Gulf of California.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 1765a, endophytic in *Grateloupia hancockii*, Bahía Bocochoibampo, near Guaymas.

*Callithamnion lejoliaea* Farl.

Pl. 8, fig. 1, 2

Farlow 1877, p. 254. *Rhodochorton amphiroae* as interpreted by Smith, 1944, p. 183, pl. 40, fig. 5-7

Thalli 1-2 mm. high, forming tufts between the integenicula of articulated corallines (*Bossiella* and *Calliarthron*), attached by a pulvinate mass of rhizoidal filaments and prostrate branchlets wedged between the segments and partially penetrating the genicula; erect filaments 20-40  $\mu$  in diam., often slightly dilated in mid-parts, terminally blunt, not at all attenuated, sparsely irregularly multifariously branched, the cells 1-2 diameters long; tetrasporangia terminal on short, 1-3-celled branchlets in lower parts of plant, ovoid, about 35  $\mu$  long; cystocarps terminal on short branchlets near the base of the plant, consisting of a subspherical gonimoblast to 50-100  $\mu$  in diam. of densely compacted carpospores; spermatangia forming terminal, elongate-capitate clusters on short branchlets.

TYPE: A collection by Mrs. E. Snyder in the Farlow Herbarium, Harvard Univ.

TYPE LOCALITY: San Diego Calif. [on a fragment of *Calliarthron*].

The type of this species has apparently not been reviewed since the plant was described 84 years ago. Although not marked as such, the type seems to consist of two small bits of a *Calliarthron* glued to separate cards and labeled as above. Examination of these has revealed tetrasporangia and cystocarps in agreement with Farlow's description and also with Smith's figures which, unfortunately, have been associated for the past two decades with *Rhodochorton amphiroae* Drew. The latter is a distinct plant reproducing by monospores, and with much more slender filaments, but otherwise of similar size and habit.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9117, Islas San Benito, on *Bossiella*. This and several collections from the southern California area had been erroneously identified as *Acrochaetium amphi-*

*roae* in the Hancock Foundation herbarium but had not been cited in publication.

***Callithamnion marshallense* Daws.**

Pl. 10, fig. 1-3

Dawson 1957, p. 117, fig. 25a-c; Dawson 1960, p. 50.

Thalli attached to other algae or to shells or debris, loosely tufted, 4-5 mm. high, consisting of an irregularly semi-prostrate part attached by modified lateral branchlets with adherent terminal discs, some of the attachment branchlets distinctly catenate in their cell form and unlike vegetative branchlets; main axis 80-90  $\mu$  in diam., non-corticated, of cells 1.0-1.5 diameters long; lateral branchlets 20-30  $\mu$  in diam., lax, long, somewhat attenuate but terminally blunt, mostly simple, curved, alternate on the bearing axis, but not always from every cell, mostly spirally arranged, often with approximately  $1/5$  divergence, but sometimes in part tending to be distichous; tetrasporangia tripartite, sub-spherical, about 40  $\mu$  in diam., sessile and adaxial, one or several in the lower half of a lateral branchlet in mid-parts of thallus.

TYPE: Dawson 13695, August 21, 1955, in Herb. Bishop Museum, Honolulu.

TYPE LOCALITY: On shells and dead coral from a depth of 6-10 feet in the lagoon, south end of Parry Island, Eniwetok Atoll.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 9018 (Hubbs, Johnson and Allanson) Laguna de San Ignacio, 3.25-3.75 m.

Although sterile, this material, like that from Bahía Uvita, Costa Rica (Dawson 1960) is much like the Eniwetok type. All came from quiet, shallow, sublittoral, bay habitats.

A strikingly similar plant is D. 2920 from a more exposed intertidal habitat at Punta Santa Rosalía. It has the same structure, branching and dimorphic rhizoidal attachments, but is somewhat coarser and shorter celled throughout. These differences may be due to the more agitated conditions of the environment.

***Callithamnion paschale* Børg.**

Pl. 9, fig. 5-6

Børgesen 1924, p. 294, fig. 35; Dawson 1959, p. 28, fig. 6b. *Callithamnion veleroae* Dawson 1944, p. 312, pl. 50, fig. 3-5.

Thalli tufted, to 2.5 cm. tall, on algal turfs, often growing on articulated corallines, attached by rhizoids; erect parts much branched, the axes to 150  $\mu$  in diameter below, ecorticate, or with a few descending filaments, of cells 1.5-2.5 diameters long, alternately branched with 4-5 orders, the branchlets ascending, gradually reduced to the ultimate ones 15-20  $\mu$  in diameter, often somewhat corymbose, of 5-15 cells 1-1.5 diameters long, blunt-tipped, the last 2-3 orders of branches usually distichous; lower orders of branches distichous, or in part irregularly

multifarious; tetrasporangia adaxial on the ramuli, elliptical, 45-55  $\mu$  in diam., solitary, sessile; spermatangia in tufts along the adaxial side of ultimate branchlets; cystocarps essentially terminal near the tips of main axes, binate, the halves almost spherical, about 130  $\mu$  in diam.

TYPE: A collection by Carl Skottsberg, probably in the Botanical Museum, Copenhagen, Denmark.

TYPE LOCALITY: Easter Island.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 195-40, Puerto Refugio (intertidal); D. 381f-40, Bahía Tepoca (22m.); D. 849, 851-2 (with some corticating filaments) Isla Jorge (intertidal); D. 46-798, Isla Patos (intertidal); D. 1004, D. 1029, Isla Partida (intertidal); D. 511, Bahía Bocochoibampo (intertidal); D. 18803, Isla Monserrate (—1 to —5 feet); D. 7072, Punta Frailes (40 m.)

Yamada's (1944) *Callithamnion minutissima* seems to be closely related here, if not identical. Described from the warmer, southern part of Japan, but never illustrated, it seems to have little to separate it from *C. paschale*. Yamada says, however, that it is "dichotomously branched in general, in the lower and middle parts of the frond dichotomously or somewhat alternate-pinnately." It is not clear how these terms should be interpreted, but if the main branching is dichotomous this would provide a ready distinction.

### ***Callithamnion ramosissimum* Gard.**

Pl. 10, fig. 6-7

Gardner 1927b, p. 404, pl. 86

Thalli epiphytic, 8-12 mm. high, attached by loose, descending rhizoidal filaments; principal axes 170-300  $\mu$  in diam. at the base, of cells about as long as broad, ecorticate or with a few descending, appressed filaments, giving off several orders of branches gradually reduced to 10  $\mu$  or less in the ultimate ones; branching alternate, spiral, polystichous, upwardly curved, the ultimate ones of 6-10 cells 2-5 diameters long, slightly attenuated, incurved, very abundant, terminally blunt; gland cells described as "sparse" in the type, not observed in the Mexican material; tetrasporangia 2-4 seriate, sometimes 2 from a single cell, sessile, adaxial on upper branchlets, broadly ellipsoidal, 50-65  $\mu$  long including the thick envelope; spermatangia densely crowded on the adaxial side of the ultimate ramuli; cystocarps unknown (modified after Gardner).

TYPE: N. L. Gardner 5034, June, in Herb. University of California, Berkeley (296618).

TYPE LOCALITY: Epiphytic on *Hypnea*, La Jolla, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8566, Isla Guadalupe, lowermost intertidal.



*Callithamnion rigidum* sp. nov.

Pl. 10, fig. 4-5

Thalli fruticulosi, ca. 1 cm. alt., axes multos ramosissimos per rhizoidea multicellularia affixos habentes; axes principales ecorticati, ca. 100  $\mu$  diam. e cellulis saepissime 1.5 plo longiores quam latae compositi, tres ordines ramorum parum attenuatorum paululum rigidorum habentes, ramis ultimis diametro ca. dimidia partis axis principalis (40-50  $\mu$ ), cellulis ubique ca. 1.2 plo longioribus quam latae; rami maxima ex parte multifarii, supra saepissime distichi, longe infra partem supremam cellulae ferentis plerumque orientes, adaxialiter curvati, ramis ultimis admodum infra cacumina quasi reductis, terminaliter, autem, obtusis; glandicellulae nullae; tetrasporangia adaxialia, in ramis ultimis seriata sessiliaque, subspherica, cum involucre crasso ca. 60  $\mu$  diam.; cystocarpi in axibus principalibus subterminales; spermatangia non visa.

Thalli tufted, about 1 cm. tall with numerous profusely branched axes attached by multicellular rhizoids; principal axes ecorticate, about 100  $\mu$  in diam., of cells mostly 1.5 diameters long, with 3 orders of little-attenuated, somewhat rigid branches, the ultimate ones about half the diameter of the main axes (40-50  $\mu$ ), the cells about 1.2 diameters long throughout; branches mainly multifarious, tending to be distichous above, usually arising well below the top of the bearing cell, adaxially curved, the ultimate ones somewhat reduced just short of the tips, but terminally blunt; gland cells absent; tetrasporangia adaxial, seriate and sessile on the ultimate branches, subspherical, about 60  $\mu$  in diam. including the thick envelope; cystocarps subterminal on principal axes; spermatangia not seen.

TYPE: Holotype is E. Y. Dawson 8576, Dec. 20-21, 1949, in Herb. A. Hancock Foundation. An isotype slide is in Herb. Beaudette Foundation.

TYPE LOCALITY: Lowermost intertidal, 2.5 miles north of South Bluff, Isla Guadalupe, Baja California, Mexico.

ADDITIONAL MATERIAL: Cooper 514, March 7, 1947, Playa Rosarita, Baja Calif.

This species shows certain resemblances to *Callithamnion rupicolum* Anders., but is ecorticate, essentially multifarious and lacks the recurved branchlets. Two collections, however, are somewhat intermediate in the last two characters. These, D. 5354, La Jolla, Calif., and D. 5570, Point Fermin, San Pedro, Calif., are irregularly distichous and show here and there a tendency toward recurved branchlets.

*Callithamnion rupicolum* Ander.

Pl. 11, fig. 1

Anderson, 1894, p. 360, figs. A-B; Collins, Holden & Setchell, Phyc. Bor.-Amer. No. 1648; Smith, 1944, p. 319, pl. 81, fig. 3; Dawson, 1951, p. 53.

Thalli tufted, mostly to 1 (2) cm. high, epiphytic or saxicolous, attached by a felted base consisting of prostrate branches and rhizoids; erect axes numerous, abundantly branched, uncorticated except by a



few loose, little-appressed, descending rhizoids near the base, 80-110  $\mu$  in diam. below, the cells 5-8 diameters long, shorter above to as little as 1 diameter long; main branching multifarious; secondary determinate branches regularly alternate and essentially distichous, divaricate, little or not at all incurved even at the tips, becoming distinctly recurved, reaching about 1 mm. in length, the cells about 1 diameter long, the tips blunt; tetrasporangia seriate and adaxial on the determinate lateral branches, ovoid, sessile, about 70  $\mu$  long, 55  $\mu$  broad; spermatangia forming a continuous row along adaxial surface of lateral branchlets almost to the tips.

TYPE: A collection by C. L. Anderson in Herb. New York Botanical Garden.

TYPE LOCALITY: Monterey Bay, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 19224 (Norris), Punta Banda (intertidal); D. 1140, D. 1198, Punta Baja (intertidal); D. 1439, D. 1474, D. 2785, Punta Santa Rosalía (intertidal); D. 9814, D. 9824, D. 9840, D. 9854, Isla Cedros (intertidal); D. 9106, D. 9118, D. 9429, Islas San Benito (intertidal); D. 9201, Bahía Asunción (intertidal); D. 9282, 9318, Isla Magdalena (intertidal).

Taylor (1945) had indicated the probable occurrence of a small form of this species in the Galapagos Archipelago, but this must be verified by further collections.

*Callithamnion soccoriense* Tayl.

Pl. 11, fig. 2-3

Taylor 1945, p. 258, pl. 86, fig. 2.

Thalli 2-4 (7) cm. tall, commonly epiphytic, consisting of soft, loose tufts of alternately branched filaments, 110-150  $\mu$  in diameter below, tapering to 70-80  $\mu$  above; principal axes uncorticated, but producing sparse, multicellular, little-branched rhizoids from the lower end of cells near the base of the plant; cells of principal axes 3-5 (8) diameters long, those of the ultimate branches (40) 50-60 (70)  $\mu$  in diam., mostly 1-2 (2.5) diameters long; branching essentially in 3 orders, tending to be distichous, the ultimate branches of 8-15 cells, 1 mm. long or more, the last 2 or 3 cells much smaller than the others, tapered to a sharp point (or sometimes blunt); tetrasporangia sessile, solitary and adaxial near the base of branchlets, about 48  $\mu$  in diam., 55  $\mu$  long; cystocarps near the tips of minor branches, about 120  $\mu$  in diam., commonly with a single lobe; spermatangia forming small (60-70  $\mu$  diam.) dense, hemispherical, serial, adaxial tufts from the distal end of lower cells of ultimate branchlets.

TYPE: Taylor 19, Jan. 2-4, 1934, in Allan Hancock Foundation Herbarium, (102).

TYPE LOCALITY: Dredged in 14-18 fms., Braithwaite Bay, Socorro Id., Revillagigedo Islands.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8299 (62-66 m.), D. 8261, D. 8423, D. 8434, D. 8435, D. 8436 (45-53 m.), D. 8460 (73 m.), Isla Guadalupe. *Revillagigedo Arch.*—Taylor 39-66B, Isla Socorro.

***Callithamnion uncinatum* sp. nov.**

Pl. 11, fig. 4

Thalli fruticulosi, ad 14 mm. alt., per massam rhizoideorum ramosorum multicellularium affixi; axes primarii erecti et multi, saepe plus minusve distiche ramosi, ecorticati nisi prope basim per rhizoidea sparsa descendunt plus minusve appressa; axes primarii ad 150  $\mu$  diam., e cellulis in partibus inferioribus 1.5-2.5  $\mu$  longioribus quam latae, supra brevioribus compositi; rami laterales determinantes plerumque distichi ca. 1-1.3 mm. long., ca. 60  $\mu$  diam., ad basim cum maturi, attenuati sed obtusi, primum prominenter forcipati et super cellulam apicalem arcuantes, cacuminibus mox rectis deinde recurvatis uncinatisque factis; tetrasporangia in latere adaxiali ramulorum lateralium seriata, sessilia ovata, 40-45  $\mu$  long., 23-26  $\mu$  lat.; reproductio sexualis non visa.

Thalli tufted, to 14 mm. high, attached by a mass of multicellular, branched rhizoids; erect primary axes numerous, frequently more or less distichously branched, uncorticated except by sparse, descending,  $\pm$  appressed rhizoids near the base; primary axes to 150  $\mu$  in diam., of cells 1.5-2.5 diameters long in lower parts, shorter above; determinate lateral branches essentially distichous, about 1.0-1.3 mm. long, about 60  $\mu$  in diam. at the base at maturity, tapering, but blunt, prominently forcipate and overarching the apical cell at first, the tips soon straightening, then becoming recurved and uncinatate; tetrasporangia seriate on the adaxial side of lateral branchlets, sessile, ovoid, 40-45  $\mu$  long, 23-26  $\mu$  broad; asexual reproduction not seen.

TYPE: Holotype is E. Y. Dawson 3814, January 10, 1947, in Herb. Beaudette Foundation.

TYPE LOCALITY: Surf, granitic headland south of Salina Cruz, Oaxaca, Mexico.

ADDITIONAL MATERIAL: D. 3779, D. 3781, vicinity of Salina Cruz, Oaxaca, Jan. 9, 1947.

This species is closely related to *C. rupicolum*, but differs in the overarching, forcipate laterals at the tips, the uncinatate character of mature laterals, and the smaller tetrasporangia.

**Key to the World Species of *Aglaothamnion***

1. Thalli less than 1 mm. high, attached by a single, partially endophytic basal cell ..... *A. monopodium* Børg. 2
1. Thalli 4 mm. high or more, attached by multiple rhizoids ..... 2
  2. Branching alternate, spiral, multifarious, becoming subdichotomous above ..... 3
  2. Branching alternate and pinnate, at least in the upper parts ..... 7
3. Branchlets often terminating in a hair ..... 4
3. Branchlets not terminating in a hair ..... 5

4. Thalli 4-5 mm. high, uncorticated at the base .....  
..... *A. sarcodiae* Børg.
4. Thalli 1 cm. high, lightly corticated at the base .....  
..... *A. brodiaei* (Harv.) Feld.-Maz.
5. Spermatangia on short lateral branchlets of 4-5 cells .....  
..... *A. furcellariae* (J. Ag.) Feld.-Maz.
5. Spermatangia sessile, in pulvinate groups on the branchlets ..... 6
6. Ultimate branches with cells about 5 diameters long; carpogonial branch zig-zag; gonimoblast very irregularly 3-lobed .....  
..... *A. neglectum* Feld.-Maz.
6. Ultimate branches with cells about 10 diameters long; carpogonial branch "U" shaped; gonimoblast irregularly heart-shaped .....  
..... *A. cordatum* (Børg.) Feld.-Maz.
7. Branching tri-pinnate in one plane .....  
..... *A. tripinnatum* (Grat.) Feld.-Maz.
7. Branching multifarious below, pinnate above ..... 8
8. Tetrasporangia subspherical; branching pinnate or secund above ..... 9
8. Tetrasporangia oblong; branching subdichotomous above ....  
..... *A. tenuissimum* (Bonnem.) Feld.-Maz.
9. Branching sparse above, often unilateral .....  
..... *A. caudatum* (J. Ag.) Feld.-Maz.
9. Branching regularly pinnate above .....  
..... *A. scopulorum* (J. Ag.) Feld.-Maz.

***Aglaothamnion cordatum* (Børg.) Feldmann-Maz.**

Pl. 12, fig. 1-3

Feldmann-Mazoyer 1940, p. 459. *Callithamnion cordatum* Børgesen 1909, p. 10; Børgesen 1917, p. 216, fig. 201-207.

Thalli epiphytic, about 2 (to 4) cm. tall, forming delicate tufts; principal axes 100-150  $\mu$  in diam. at the base, attached by slender, little-branched, multicellular rhizoids, the cells 1-2 diameters long near the base, producing a single, slender, descending, closely appressed rhizoid from the basal cell of each lateral branch; axial cells longer above, 3-6 diameters long, gradually attenuated through successive branch orders; principal branching regularly alternate, spiral, from the distal end of axial cells, the basal cell of a lateral branch often much smaller in diameter than the axis; lateral branches with 4 or more orders of dichotomous branches, the ultimate ones of 3-7 cells, 50-70  $\mu$  long, 7-10  $\mu$  in diam., with minutely blunt tips, all ascending and inwardly curved; tetrasporangia scattered throughout the upper branches, adaxial, sessile, at first clavate then ovoid, 40-50  $\mu$  long; spermatangia borne in pulvinate, adaxial clusters along branchlets of

last several orders; cystocarps binate, the lobes somewhat irregularly heart-shaped or triangular.

TYPE: A Børgesen collection, March, probably in the Botanical Museum of Copenhagen.

TYPE LOCALITY: Epiphytic on *Gracilaria*, 15 fms. Cruzbay, Virgin Islands.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8256 (48-56 m.), D. 8277 (76-100 m.), D. 8280, D. 8422 (48-56 m.), D. 8431, 8434 (48-56 m.) Isla Guadalupe.

The Guadalupe Island specimens show such extraordinary resemblance to Børgesen's West Indian plant that there seems little question of their identity and of the occurrence of this genus, heretofore unreported in the Pacific.

***Aglaothamnion brodiaei* (Harv.) Feldmann-Maz.**

Pl. 12, fig. 4-5

Feldmann-Mazoyer 1940, p. 452, fig. 177. *Callithamnion brodiaei* Harvey, in Hooker 1833, p. 340; Rosenvinge 1923-24, p. 313, fig. 224-228. *Callithamnion byssoides* as interpreted by Setchell & Gardner 1930, p. 167, and by Dawson 1960, p. 50.

Plants epiphytic, 1 cm. high or less, consisting of several erect, multifarious axes from a rhizoidal attachment; erect axes 100-140  $\mu$  in diam. at the base, lightly corticated near the base by descending, appressed filaments, the cells mostly 1.5 diameters long, gradually reduced to the ultimate branchlets which are 6-10  $\mu$  in diam.; branching attenuate, spiral, of several orders, the ultimate ones of 1-4 cells, 2-4 diameters long, commonly terminating in a hair, longer in sterile plants; gland cells absent; tetrasporangia sessile, subspherical, about 60  $\mu$  in diam. including the thick envelope, adaxial on the upper branches; spermatangia in spreading adaxial tufts along upper branchlets; gonimoblast consisting of two large, rounded to cordiform gonimolobes and two smaller ones.

TYPE: A collection by Mr. Brodie, probably in the Harvey Herbarium, Trinity College, Dublin, Ireland.

TYPE LOCALITY: Forres, England.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Mason 89 "on eel grass," D. 4089 (20-30 m.), D. 19249 (C. Limbaugh, on *Codium*), D. 19253 (38 m.), Isla Guadalupe.

Comparison of the abundantly fertile collections from Isla Guadalupe with Feldmann-Mazoyer's account of *Aglaothamnion* reveals that this plant had best be assigned here in keeping with the characters of the gonimoblast and abundant hairs on the branch tips. Assignment of these specimens previously to *Callithamnion byssoides* had not taken these features into account. All of these, however, are smaller and much less corticated plants than the relatively coarse specimens originally



described by Harvey from England. The apparent wide range of the species calls for a more complete study of its variability and ecology.

### Working Key to the North Pacific Species of Pleonosporium

1. Thalli partially endophytic in *Codium* .... *P. codicolum* sp. nov.
1. Thalli not endophytic ..... 2
  2. Thalli corticated, at least below ..... 3
  2. Thalli without significant cortication ..... 6
3. Thalli distichously branched essentially in one plane throughout ..... 4
3. Ramuli of higher orders polystichous .... *P. polycarpum* Gardner
  4. Plants under 2 cm. high ..... *P. pygmaeum* (but see *P. dasyoides*)
  4. Plants 4-15 cm. high ..... 5
5. Polysporangia sessile; plants lightly corticated below ..... *P. complanatum* Tayl.
5. Polysporangia pedicellate; cortication usually heavy except near branch tips ..... *P. dasyoides* (*P. pygmaeum* appears to be a dwarfish, little-corticated variant of this)
6. Thalli radially branched ..... *P. globuliferum* Leving
6. Thalli distichously branched ..... 7
7. Cells of main axes only about as long as wide ..... *P. pinnatum* Okamura & Segawa
7. Cells of main axes mostly 1.5 to 4 diameters long ..... 8
  8. Determinate branches from principal axes usually simple .... 9
  8. Determinate branches from principal axes usually with 1 or more orders of branchlets ..... 11
9. Plants 5 mm. high or less; polysporangia with about 12 spores ..... *P. pusillum* Yamada
9. Plants 2.5-5 cm. high; polysporangia with about 32 spores ..... 10
  10. Lower parts loosely clothed with rhizoids; polysporangia grouped, not seriate, borne on short branchlets in special fertile areas ..... *P. rhizoideum* sp. nov.
  10. Lower parts not especially clothed with rhizoids; polysporangia seriate, sessile and adaxial on ordinary determinate lateral branchlets ..... *P. mexicana* sp. nov.
11. Lateral branches usually bearing an abaxial branchlet from the basalmost cell ..... 12
11. Lateral branches usually with lowermost cell lacking a branchlet and the first branchlet arising adaxially from the second cell ..... 14
  12. Plants  $\pm$  densely branched in 4-5 orders; polysporangia and spermatangia unknown ..... *P. abyssicola* Gardner
  12. Plants  $\pm$  openly branched in mostly 3 orders ..... 13

- 13. Polysporangia oviform; spermatangia secund .....  
..... *P. squarrosus* Kylin
- 13. Polysporangia ellipsoidal; spermatangia alternate .....  
..... *P. vancouverianum* J. Ag.
- 14. Polysporangia sessile and usually adaxially secund .....  
..... *P. tohyamanum* Tokida & Inaba<sup>3</sup>
- 14. Polysporangia pedicellate, in groups, not secund .....  
..... *P. kobayashii* Okamura

### **Pleonosporium abysicola** Gard.

Pl. 13, fig. 3

Gardner 1927a, p. 380, pl. 81, fig. 1, pl. 82.

Thalli 15-18 mm. high, with 1 or a few percurrent, uncorticated axes 200-235  $\mu$  in diam. at the base, with 5 orders of branches, each decidedly smaller than the preceding, all branches and ramuli distichous and alternate, arising from every cell, successively reduced but not attenuated, the tips blunt; cells of primary axes and major branches (1.5) 2.5-3.0 diameters long, those in the ultimate ramuli 1-2 diameters long, the basal cells of all orders of branches much shorter than the others, each giving rise to the first branch of the next order on the abaxial side; ultimate branchlets of 2-6 cells; polysporangia elliptical, 80-90  $\mu$  long, usually 2, sessile and alternate on the subultimate branchlets; spermatangia unknown (modified from Gardner).

TYPE: N. L. Gardner 6010, July, in Herb. University of California, Berkeley (296614).

TYPE LOCALITY: Dredged from 15-20 fms. near Friday Harbor, Washington.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8024, Tanner Bank (70 m.); D. 8452, Isla Guadalupe (90 m.); D. 9034, Sacramento Reef (57 m.); D. 9323, Isla Magdalena, drift.

This species has been reported heretofore only as the type. Despite the fact that it was described in the absence of polysporangia and the type was described as having much longer axial cells, we attribute these more ample Mexican specimens to this species and have modified Gardner's description. Study of Gardner's type figures reveals that the cells of the principal axes and of the primary branches are for the most part 2.5-3.0 diameters long, although he describes them as 3-4 and 4-6 diameters long, respectively.

### **Pleonosporium codicolum** sp. nov.

Pl. 14, fig. 4-5

<sup>3</sup>Reexamination of a part of the type of *P. venustissimum* (Mont.) DeToni has shown that Kützing's figure was inaccurately drawn and that the branching characters of this species are essentially like those of *P. tohyamanum*, although the longer axial cells of the former and other features may ultimately be found to distinguish them. (Plate 13, fig. 4) See also Howe, 1914, p. 150.

Thalli partim endophytici, e filamentis profunde inclusis, cellulis 30  $\mu$  diam., 100-150  $\mu$  long. constantes; filamenta inter utriculos *Codii* remote alterne ramosa, ad superficiam filamenta 500-800  $\mu$  long. libera brevia erecta ramosa producentia; filamenta libera irregulariter semel vel bis alterne aut subdichotome ramosa, non in eodem plano, e cellulis plerumque 1.0-1.5 plo longioribus quam latae composita, haud attenuata, cacuminibus obtusis; polysporangia subspherica aut ovata, ad 100  $\mu$  long., 12-18 sporas habentia, reproductio sexualis non visa.

Thalli partly endophytic, consisting of deeply embedded filaments, with cells 30  $\mu$  in diam., 100-150  $\mu$  long, ramifying between *Codium* utricles, remotely alternately branched, at the surface producing short, erect, branched, free filaments 500-800  $\mu$  long; free filaments irregularly once or twice alternate or subdichotomous, not in one plane, of cells mostly 1.0-1.5 diameters long, not at all attenuated, the tips blunt; polysporangia subspherical or ovoid, to 100  $\mu$  long, with 12-18 spores; sexual reproduction not seen.

TYPE: Holotype is E. Y. Dawson 8318, December 18, 1949, in Herb. A. Hancock Foundation; an isotype slide is in Herb. Beaudette Foundation.

TYPE LOCALITY: Endophytic in *Codium fragile*, intertidal, extreme south tip of Isla Guadalupe, Baja California, Mexico.

**Pleonosporium dasyoides** (J. Ag.) G. DeToni

Pl. 13, fig. 1-2

G. DeToni, 1903, p. 1310; Kylin, 1941, p. 28; Dawson, 1946c, p. 83; *Callithamnion dasyoides* J. G. Agardh, 1876, p. 31.

Thalli 5-10 cm. tall, usually epiphytic (sometimes on hydroids, etc.), alternately more or less distichously branched, the upper main branches from the primary axis often longer than the lower ones; primary axes and branches of first and second orders corticated by slender, branched, descending rhizoidal filaments from the basal cell of lateral branches; primary axes 300  $\mu$  in diam. or more, to 1 mm. near the base; ultimate indeterminate branchlets of 11-16 cells about as long as broad, about 40  $\mu$  in diam. at the base, somewhat tapered, more or less adaxially curved, terminally blunt; polysporangia terminal on simple or compound branchlets of 1-several cells from near the base (adaxial, sometimes also abaxial) of determinate laterals, elliptical, about 65-75  $\mu$  long; spermatangia forming a terminal subcylindrical or subconical compact cluster on ultimate branchlets, the sterile base of 1-3 cells.

TYPE: Not specifically designated, represented by at least 2 specimens in Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: Not specifically designated, indicated as "Chile" and "California." The type of the California plant is represented by a specimen marked *Callithamnion dasyoides*  $\beta$  *californicum* without definite locality.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 173-45, Punta

Descanso; D. 68, D. 5179, D. 6482, D. 6483, Cabo Colnett (intertidal); D. 8915, Punta Baja (intertidal); D. 9765 Bahía Blanca (18-30 m.).

**Pleonosporium globuliferum** Levr.

Pl. 15, fig. 2-6

Levring 1941, p. 647, fig. 19; Dawson 1960, p. 50

Thalli 6-7 mm. high (epiphytic, often on *Codium*), attached by a group of branched, multicellular, penetrating rhizoids, tufted, consisting of several erect, multifariously branched axes; primary axes uncorticated, 70-110  $\mu$  in diam. of cells 1.0-1.5 diameters long near the base, longer (to 4 diameters) above; branching multifarious throughout, the determinate lateral branches 1 mm. long or more, ascending and somewhat incurved, about 30  $\mu$  in diam. at the base, of cells 3-4 diameters long, tapering to about 12  $\mu$  in diam., the tips blunt; polysporangia sessile, subspherical, scattered along lateral branches, mainly adaxial, about 40  $\mu$  in diam.; spermatangial clusters subcylindrical, about 80  $\mu$  long, 30  $\mu$  in diam., sessile along adaxial side of lateral branchlets.

TYPE: A collection by Carl Skottsberg, 14 March, 1917, in the Herbarium of the Botanical Garden, Göteborg, Sweden.

TYPE LOCALITY: "ausserhalb Sanchez, Masafuera" Island, Islas Juan Fernandez, Chile.

Mexican Distribution: *Pacific Baja Calif.*—D. 8521 (on *Codium*, intertidal, D. 8237 (on *Sargassum*, 6-29 m.), Isla Guadalupe. *South-eastern Baja Calif.*—D. 3093, Cabo Pulmo, on *Sargassum*. *Oaxaca*—D. 21433, Puerto Guatulco.

**Pleonosporium mexicanum** sp. nov.

Pl. 16, fig. 1

Thalli 2-5 cm. alt., fruticosi, abunde ramosi, constantes ex axibus multis e basi per rhizoidea affixa orientibus; axes ecorticati 120-200  $\mu$  diam., sursum gradatim reducti, cellulis longitudine variantibus, saepe in partibus infimis aequae longis ac latis, in partibus mediis 2-4 plo longioribus quam latae, supra breviores rursus (c. 1.5 plo longioribus quam latae); alterni distichi, non ex omni cellula orientes; rami primarii plerumque sine ramis in partibus inferioribus mediisque, supra ramulis lateralibus distichis alternis determinatisque ex omni cellula praediti; ramuli determinati laterales plerumque simplices, e 15-30 cellulis compositi, valde incurvati satis corymbosi ad basim 40-70  $\mu$  diam., e cellulis 1-2 plo longioribus quam latae compositi, ad cacumen obtusum gradatim reducti, (non, autem, attenuati, cellula basali paulo brevioribus quam aliae; polysporangia seriata sessilia, in ramulis lateralibus determinatis adaxialia, late ovata, cum involucre crasso c. 90  $\mu$  diam., c. 32 sporas habentia; reproductio sexualis non visa.

Thalli 2-5 cm. tall, bushy, abundantly branched, consisting of numerous axes from a rhizoidially attached base; axes ecorticate, 120-200  $\mu$  in diam., gradually reduced upwards, the cells of variable length, often 1 diam. long in lowermost parts and to 2-4 diameters long in mid-parts



shorter again (about 1.5 diameters) above; branching alternate, distichous, not from every cell; primary branches commonly barren of branches in lower and mid-parts, provided with distichous, alternate determinate lateral branchlets from each cell above; determinate lateral branchlets usually simple, of 15-30 cells, strongly incurved, somewhat corymbose, 40-70  $\mu$  in diam. at the base, of cells 1-2 diameters long, gradually reduced (but not attenuated) to a blunt tip, the basal cell only a little shorter than the others; polysporangia seriate, sessile, adaxial on the determinate laterals, broadly ovoid, about 90  $\mu$  in diam. including the thick envelope, with about 32 spores; sexual reproduction not seen.

TYPE: Holotype is E. Y. Dawson 3610, Dec. 8, 1946, in Herb. Beaudette Foundation.

TYPE LOCALITY: Lowermost intertidal on small reef 3 km. north of Belmar Hotel (Playa de Olas Atlas), Mazatlán, Sinaloa, Mexico.

ADDITIONAL MATERIAL: *Pacific Baja Calif.*—D. 8450, Isla Guadalupe (not corymbose and the branchlets little incurved, but otherwise similar). *Gulf of Calif.*—D. 851a, Isla Jorge; D. 789, Isla Patos; D. 1004, Isla Partida; D. 680, Puerto Libertad; D. 21691, 21705, Bahía Bocochoibampo, near Guaymas. *Sinaloa*—D. 3591, D. 3657, D. 3666, D. 3632, D. 10834, Mazatlán. *Nayarit*—D. 10860, 10861, 10875, Mira Mar.

The long, usually simple, strongly incurved and  $\pm$  corymbose determinate branchlets are distinctive in this species as is also the barren condition of the lower parts of the primary branches from the principal axes.

### *Pleonosporium pygmaeum* Gard.

Gardner 1927a, p. 379, pl. 79, fig. 2, pl. 80.

This appears to be a dwarfish, little-corticated variant of *Pleonosporium dasyoides* and may ultimately be reduced. It is recognized by its smaller stature (6-20 mm.) and the restriction of corticating filaments to the very base. A single collection available to me (D. 8010 from 30-38 m. at Cortes Bank) agrees with Gardner's description but does not lend credence to specific recognition.

### *Pleonosporium rhizoideum* sp. nov.

Pl. 14, fig. 1-3; Pl. 17, fig. 7

Thalli penicillatim ramosi, ad 2.5 cm. alt., constantes ex axibus multis ramosis erectis, e massa conferta coacta rhizoiderorum adhaerentium formantium, orientibus; axes erecti ad basim 125-170  $\mu$  diam., in partibus inferioribus per rhizoidea implicata plus minusve laxe vestiti, e cellulis (1) 1.5-2.0 plo longioribus quam latae, admodum distiche ramosis compositi, rami magna ex parte simplices longissimi, primum valde incurvati deinde irregulariter curvati recurvative, paululum imbricati (interdum extrema in parte uncinati) 60-70  $\mu$  diam., paulum attenuati, cacuminibus acutius reductis sed obtusis, ad formandum rhizoideum interdum productis; polysporangia in partibus thalli propriis dense ramosis nata, ramis brevibus irregularibus, polysporangia aggregata alterna sessilia spherica, c. 60  $\mu$  diam., 32 sporas continentia, ferentibus;

cystocarpi subspherici c. 90  $\mu$  diam., aliquot lobos humiles irregulares habentes, in partibus thalli fertilibus ramossissimis, partibus sporangialibus similibus nati.

Thalli tufted, to 2.5 cm. tall, consisting of many erect, branched axes from a dense mass of rhizoids forming a felted attachment; erect axes 125-170  $\mu$  in diam. at the base, more or less loosely clothed in lower parts by entangled rhizoids, of cells (1)-1.5-2.0 diameters long, essentially distichously branched, the branches mostly simple, very long, at first strongly incurved, then irregularly curved or recurved, somewhat entangled (sometimes terminally uncinata) 60-70  $\mu$  in diam., little attenuated, the tips rather sharply reduced but blunt, sometimes prolonged to form a rhizoid; polysporangia borne in special, densely branched parts of thallus, the branches short, irregular, bearing groups of alternate, sessile, spherical polysporangia about 60  $\mu$  in diam., containing 32 (?) spores; cystocarps subspherical, about 90  $\mu$  in diam., with several low, irregular lobes, borne in densely branched fertile parts of thallus similar to sporangial ones.

TYPE: Holotype is E. Y. Dawson 3774, Jan. 9, 1947, in Herb. Beaudette Foundation.

TYPE LOCALITY: Salina Cruz, Oaxaca, Mexico.

ADDITIONAL MATERIAL: D. 3783, D. 3814a, Salina Cruz, Oaxaca.

### *Haloplegma mexicanum* Tayl.

Taylor 1945, p. 262, pl. 86, fig. 1.

Plants to 10 cm. tall, tufted, rose-pink above, discolored below, flabellately expanded, the branching irregularly alternate from the margin, the branches crenate to irregularly pinnately lobed or again branched, spongy throughout, above very thin and delicate, but below thicker; internally consisting of branched, uniseriate, longitudinal filaments supporting a network of filaments in quadrilateral meshes which at the surface of the plant bear groups of erect, sharp-tipped, free, alternately branched filaments 7-8 cells in length, the cells 1-2 diameters long, 25-35  $\mu$  in diam. (from Taylor).

TYPE: Taylor 39-644, May 9, 1939, in Herb. A. Hancock Foundation.

TYPE LOCALITY: Dredged from a bottom of coralline and other algae at Hancock Station 970, Isla María Magdalena, Islas Tres Mariás, Mexico.

### *Lejolisia colombiana* Tayl.

Pl. 17, fig. 1-5

Taylor 1945, p. 265, pl. 4, fig. 3-10

Thalli small, tufted, the basal filaments creeping, to 24  $\mu$  in diam., the branches chiefly erect, to 3-5 mm. tall, little tapered, about 18  $\mu$  in diam., the cells about 100  $\mu$  long below, 70  $\mu$  long above, simple

or sparingly branched, the branches erect, the apical cells long, obtuse; sporangia unilateral on the erect branches, on 1-2-celled, upcurved pedicels, tetrahedral, oval, about  $28\ \mu$  in diam.,  $42\ \mu$  long; spermatangia in clusters terminating the erect axes or lateral branchlets, the clusters cylindric-oval, (80)  $100\text{--}115\ \mu$  long,  $35\ \mu$  in diam.; cystocarps terminal on the erect branches or few-celled lateral branchlets, the pericarp-like investment turbinate, to  $175\ \mu$  in diam.,  $150\ \mu$  long (to  $138\ \mu$  long,  $110\ \mu$  wide in Mexican specimens). (modified after Taylor).

TYPE: Taylor 34-495B p.p., Feb. 12, 1934, in Herb. A. Hancock Foundation.

TYPE LOCALITY: Forming tufts, Isla Gorgona, Valle, Colombia.

MEXICAN DISTRIBUTION: *Baja Calif.*—D. 3321b, Cabeza Ballena; D. 3239, 3265, Punta Palmilla; D. 3106, Cabo Pulmo.

***Tiffaniella saccorhiza* (S. & G.) Doty & Meñez**

P. 16, fig. 2

Doty & Meñez 1960, p. 135-144, fig. 1-4. *Spermothamnion saccorhiza* (Setchell & Gardner) Feldmann-Mazoyer 1942, p. 16. *Pleonosporium saccorhiza* Setchell & Gardner 1930, p. 168.

Thalli monosiphonous, uncorticated, consisting of an extensive, branched, creeping portion attached to the host by numerous penetrating rhizoids from below, and of erect axes arising from the creeping portion; erect parts 2-3 mm. high, subdichotomously branched,  $26\text{--}30\ \mu$  in diam. at the base, tapering but very slightly to the blunt apices; cells 8-12 diameters long; rhizoids prolonged, pink colored, consisting of single cells  $300\text{--}500\ \mu$  long, very much swollen in the middle, terminating in an irregularly saccate swelling; polysporangia sparse, 2-3 arising on short branches in the lower and upper parts of the plant, spherical to slightly elongated, on 1-celled pedicels,  $75\text{--}85\ \mu$  in diam., with approximately 32 spores and with thick walls; spermatangia borne on solitary, terminal stichidia from the lower parts of erect systems; carpogonial branches subterminal, the gonimoblast without a conspicuous central fusion cell.

TYPE: H. L. Mason 37, April, in Herb. California Academy of Sciences (173630).

TYPE LOCALITY: Growing on *Codium* sp., Isla Guadalupe, Baja Calif., Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 10040 (on *Codium fragile*, D. 10292 (on *C. hubbsii*, "Velero Point" about 10 mi. west of Punta Malarrimo).

This segregate from *Spermothamnion* shows many resemblances to *S. snyderae*, and the basis of generic distinction has not yet been well tested.

**Spermothamnion snyderae** Farl. var. *snyderae*

Pl. 16, fig. 3-5

Farlow 1899, p. 74; Dawson 1945, p. 67; Dawson 1949, p. 220; Dawson 1950, p. 155, fig. 24-25; Dawson 1951, p. 53; Dawson, Neushul & Wildman 1960, p. 80, pl. 36, fig. 1-2.

Thalli 1-3 (5) cm. tall, consisting of erect, finely hair-like filaments from prostrate filaments attached by rhizoids with discoid ends; erect filaments rather sparsely, mostly unilaterally branched, seldom with more than 3 orders, 50-110  $\mu$  in diam., of cells mostly 5-7 (10) diameters long; branches of successive orders of approximately the same breadth, the ultimate ones about 0.7 times the diameter of basal ones; cystocarps without an involucre, forming a loose terminal cluster 350  $\mu$  in diam.; tetrasporophytes with polysporangia only, these borne terminally on short, simple or compound branchlets in lower and middle parts of erect filaments; polysporangia broadly ellipsoidal, 95-130  $\mu$  long, 75-120  $\mu$  in diam., with 8-32 (usually 12-16) polyspores; spermatangia forming cylindrical, compact, sessile heads about 150  $\mu$  long, 50  $\mu$  in diam. arranged in short adaxial series on 5-7-celled, incurved, fertile branchlets in middle and upper parts of plants.

TYPE: Not specifically designated, represented by collections of Mrs. Snyder, Mrs. Bingham, Mr. Cleveland, in the Farlow Herbarium of Harvard University.

TYPE LOCALITY: Not specifically designated: "Santa Cruz, Santa Barbara, San Diego, Calif."

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 242, 279, Cooper 823, near Punta Descanso; D. 101, Cabo Colnett; D. 8890, Punta Baja; Williams 5/24/46, Isla San Martín; D. 10550, Punta Norte, Isla Cedros; D. 2847, near Punta Santa Rosalía; D. 13351, Punta Thurloe; D. 9538, Punta Abreojos; D. 9213, 9173, Bahía Asunción; D. 13291, Isla Margarita. *Gulf of Calif.*—D. 852, Isla Jorge; D. 759, Isla Patos; D. 717, Puerto Libertad; D. 610, Ensenada de San Francisco.

The Gulf of California specimens are generally smaller and more delicate than those from the outer coast and have usually solitary, pedicellate polysporangia rather than groups of two to six, but intermediate conditions have been observed along southern Pacific Baja California which indicate that the range of the species extends into the cooler, northern Gulf of California and includes these more delicate forms. In that region the plant seems to be a winter annual, for, from Guaymas to Isla Jorge, it has been found only in February.

**Spermothamnion snyderae** var. *attenuata* var. nov.

Varietas speciei similis sed tenuior, 1 cm. alt., axibus infra 50-80  $\mu$  diam., supra ad 15-12  $\mu$  diam. attenuatissimis factis.

Like the species but more delicate, 1 cm, high, the axes 50-80  $\mu$  in diameter below and becoming remarkably attenuated to 15-12  $\mu$  in diameter above.



TYPE: Holotype is E. Y. Dawson 8587, Dec. 20, 1949, in Herb. A. Hancock Foundation.

TYPE LOCALITY: Intertidal at -1.7 foot tide level, 2.5 miles north of South Bluff, Isla Guadalupe.

ADDITIONAL MATERIAL: D. 8227, dredged, 6-20 m., South Anchorage, Isla Guadalupe.

### Working Key to the North Pacific Species of *Ceramium*

1. Thallus completely corticated throughout ..... 2
1. Thallus with nodal cortication for the most part continuous, but at least in some part with ecorticate internodal spaces, or the cortex thin and loose over internodes ..... 13
1. Thallus with cortication only at the nodes, or with uninterrupted cortication only in older, lower parts or on reproductive branches ..... 14
  2. Thallus bearing deciduous or persistent spines on apices or on short lateral branches ..... 3
  2. Spines absent ..... 4
3. Sharp unicellular spines present at apices or terminating short lateral branchlets ..... *C. horridum* S. & G.
3. Two or more multicellular spines terminating mature apices on main or lateral branches .....
  - ..... *C. pacificum* (Collins) Kylin (in part)
  4. Plants bearing conspicuous sickle-shaped swollen branchlets ..... *C. hypnaeoides* (J.Ag) Okam. (*Campylaeophora hypnaeoides* J. Ag.)
  4. Plants without sickle-shaped branchlets ..... 5
5. Cortical cells, at least for the greater part, in distinct longitudinal rows; with gland cells in the nodal cortex .....
  - ..... *C. eatonianum* (Farl.) DeToni
5. Cortical cells not in distinct longitudinal rows; gland cells absent ..... 6
  6. Plants large (10-15 cm.) with special whorls of fertile ramuli below ..... *C. boydenii* Gepp
  6. Plants smaller, without special whorls of fertile ramuli ..... 7
7. Plants with penetrating, bulb-tipped, pigmented rhizoids .....
  - ..... *C. codicola* J. Ag.
7. Plants without bulbous rhizoids ..... 8
  8. Plants robust, the cortex 200  $\mu$  thick or more ..... 9
  8. Plants not especially robust; cortex much thinner ..... 10
9. Plants creeping ..... *C. obesum* Dawson
9. Plants erect, epiphytic ..... *C. crassum* Okam.
  - ..... (*Campylaeophora crassa* (Okam.) Nakamura)

10. Branching sparse; nodes not evident .....  
..... *C. howellii* S. & G.
10. Branching more or less abundant; nodes evident ..... 11
11. Apices more or less incurved; with many proliferous branches,  
but these not congested in upper parts .....  
..... *C. pacificum* (Collins) Kylin (in part)  
(Note that *C. kondoi* Yendo em. Nakam. keys out here and is  
distinct from both *C. pacificum* and *C. rubrum* (Huds.) Ag.)
11. Apices straight ..... 12
12. Plants 15-25 mm. high; apices divergent; with many  
short proliferous branches densely congested above .....  
..... *C. viscainoense* Daws.
12. Plants 2.5-10 cm. high; apices not particularly divergent;  
branches not especially congested above .....  
..... *C. japonicum* Okam.
13. Cortical bands only slightly separated above, covering the  
expanding internodes below by basipetal growth, but the  
secondary cortication thin, loose, often incomplete; with many  
proliferous branchlets. .... *C. washingtoniense* Kylin  
(*C. hoodii* Taylor keys out here and is remarkably similar to  
*C. washingtoniense* despite wide geographic separation)
13. Nodal cortication discontinuous, particularly so in lower parts,  
usually continuous above or irregularly discontinuous; usually  
with conspicuous proliferous branchlets .....  
..... *C. sinicola* S. & G.
14. Plants bearing conspicuous multicellular spines ..... 15
14. Plants without conspicuous spines ..... 16
15. Spines mainly abaxial, more or less deciduous .....  
..... *C. paniculatum* Okam.
15. Spines whorled at the nodes, persistent .....  
..... *C. hamatispinum* Daws.
16. Cortical bands showing conspicuous basipetal and (or)  
acropetal secondary growth ..... 17
16. Cortical bands without conspicuous basipetal or acropetal  
secondary growth ..... 18  
(But see *C. personatum* which has in part basipetal  
rhizoidal cells.)
17. Tetrasporangia immersed within the cortical band .....  
..... *C. evermannii* S. & G.
17. Tetrasporangia projecting from the cortical band .....  
..... *C. californicum* J. Ag.

18. Cortical cells arranged in distinct horizontal *and* vertical rows in lower two-thirds of nodes ..... *C. recticorticum* Dawson 19
18. Cortical cells not arranged in vertical rows ..... 19
19. Branching sympodial ..... *C. sympodiale* Dawson 20
19. Branching dichotomous or irregular, but not sympodial ..... 20
20. Outer cortical cells of nodal band separated into two groups by a horizontal clear space usually at about the lower third of the node; tetrasporangia involucrate ..... 21
20. Outer cortical cells of nodal band not clearly divided into two groups; tetrasporangia immersed, involucrate or naked ..... 23
21. Nodes of most filaments each bearing, at first abaxially, a short, thick, apically rounded, unicellular hair, or these later sometimes whorled ..... *C. fimbriatum* S. & G. 22
21. Nodes without such a specialized hair ..... 22
22. Cells of lower portion of divided cortical band distinctly and persistently elongated horizontally ..... *C. gracillimum* v. *byssoideum* (Harv.) Feldm.-Maz. 22
22. Cells of lower portion of divided cortical band, except in young stages, angular, small and not distinctly horizontally elongated ..... *C. taylorii* Dawson 23
23. Tetrasporangia immersed, not individually prominent or projecting, although the nodes may be tumid ..... 24
23. Tetrasporangia naked or involucrate, projecting ..... 30
24. Plants procumbent, with conspicuous opposite branching in lower parts ..... *C. procumbens* S. & G. 25
24. Plants erect or entangled, without conspicuous opposite branching ..... 25
25. Cortical bands narrow, usually less than half as high as wide, with a central row of large cells bordered by small ones ..... *C. marshallense* Daws. 26
25. Cortical bands thicker, more than half as high as wide, the cells  $\pm$  uniform ..... 26
26. Axes 140-200  $\mu$  in diam.; cortication relatively complete, the nodal bands covering most of axes ..... *C. sinicola* S. & G. (in part) 27
26. Axes 80-130  $\mu$  in diam.; nodal cortication truncated above and below, the ecorticate internodes prominent .... 27
27. Tetrasporangial nodes tumid, providing a strongly banded effect to axes; sterile tips non-forcipate ..... 28
27. Tetrasporangial nodes not tumid, the fertile areas swollen but not strongly banded; sterile tips forcipate ..... 29

28. Branching dichotomous ..... *C. nakamurai* Daws.  
 28. Branching irregular, not dichotomous. ....  
       ..... *C. vagabunde* Daws.
29. Tetrasporangial axes non-forcipate, usually terminally swollen  
       ..... *C. equisetoides* Daws.
29. Tetrasporangial axes forcipate, the swollen portion well below  
 the tips ..... *C. templetonii* S. & G.
30. Tetrasporangia naked ..... 37
30. Tetrasporangia involucrate, at least by bracteate  
 filaments ..... 31
31. Filaments less than 70  $\mu$  in diam. .... 32
31. Filaments 70-200  $\mu$  in diam ..... 34
32. Tetrasporangia solitary at the nodes, the involucre  
 unilateral ..... 33
32. Tetrasporangia whorled at the nodes, the involucre  
 symmetrical ..... *C. camouii* Daws
33. Tetrasporangia 40-80  $\mu$  diam.; filaments 40-70  $\mu$  diam.;  
 cavity of axial cells terminally acute, basally truncate. ....  
       ..... *C. mucronatum* Segi
33. Tetrasporangia 20-40  $\mu$  diam.; filaments 30-40  $\mu$  diam.; axial  
 cells symmetrically elliptical ..... *C. serpens* S. & G.
34. Lower internodes 5-10 diameters long .....  
       ..... *C. tenerrimum* (Mart.) Okam.
34. Lower internodes mostly 2 diameters long ..... 35
35. Cortical band 1/3 to 1/2 as long as broad; tetrasporangia  
 secund, abaxial, sometimes later whorled, conspicuously involu-  
 crate throughout; without rhizoidal appendages lying against  
 the axial cells ..... *C. mazatlanense* Daws.
35. Cortical band about 1/2 as long as broad or more ..... 36
36. Tetrasporangia initially secund, mainly abaxial, later  
 whorled and somewhat involucrate; with descending  
 rhizoidal appendages from some of the inner cortical  
 cells lying against the axial cells .....  
       ..... *C. personatum* S. & G. (in part)
36. Tetrasporangia initially secund, mainly adaxial, later  
 whorled, slightly involucrate; without rhizoidal append-  
 ages from the cortical cells ..... *C. gardneri* Kylin
37. Plants smaller, the lower nodes rarely exceeding 130  $\mu$  in  
 diam. .... 38
37. Plants larger, the lower nodes 150-450  $\mu$  in diam ..... 41
38. Upper internodes ordinarily less than 3 times as long as  
 cortical band; adult nodes of more than 2 tiers of cells.... 39



38. Internodes, except near tips, 4-10 times as long as cortical band; nodes of only 2 tiers of cells ..... *C. affine* S. & G. (Japanese plants treated by Tokida as *C. cimbricum* Peters. are very similar and perhaps not distinct, but the type of that little-known European species was sterile.)
39. Lower internodes 2-6 diameters long; nodes often with whorled rhizoids ..... *C. tenuissimum* J. Ag.? (Japan)
39. Lower internodes mostly less than 2 diameters long; without whorls of rhizoids at the nodes ..... 40
40. Lower cells of cortical band producing descending rhizoidal appendages lying along axial cell wall .....  
..... *C. personatum* S. & G. (in part)
40. Not as above ..... 41
41. Cortical band consisting of larger, rounded, downwardly directed cells in lower part of band, and smaller, angular cells in upper part; lower internodes 1.5-2.0 times as long as broad; branching distant ..... *C. caudatum* S. & G. (in part)
41. Cortical bands with irregularly arranged, small, angular cells on the surface throughout; lower internodes mostly less than as long as broad; branching rather dense above .....  
..... *C. zacaе* S. & G. (in part)
42. Upper branches reduced in diameter, commonly 100  $\mu$  or less; tetrasporangia appearing large compared to bearing cortical band, 1/4 the diameter of the band or larger .... 43
42. Upper branches not much reduced in diameter, commonly over 150  $\mu$  (to 300  $\mu$ ); tetrasporangia mostly appearing small compared to bearing cortical band ..... 44
43. Older internodes less than as long as broad .....  
..... *C. zacaе* S. & G. (in part)
43. Older internodes 1.5-2.5 times as long as broad .....  
..... *C. caudatum* S. & G. (in part)
44. Apices prominently circinate-forcipate; tetrasporangia mainly projecting from adaxial surface of the node or sometimes scattered around the entire node .....  
..... *C. clarionense* S. & G.
44. Apices not circinate; tetrasporangia whorled, projecting from upper half, particularly the upper margin, of the cortical band ..... *C. ornatum* S. & G.

***Ceramium affine* Setch. & Gard. var. *affine***

Pl. 17, fig. 6

Setchell & Gardner 1930, p. 172; Dawson 1944, p. 317, pl. 51, fig. 4; Dawson 1950, p. 132.

Thalli 8-12 mm high, epiphytic or entangled, 30-40  $\mu$  in diam, at the

base, not tapering perceptibly except from the last 2-3 nodes to the apex. dichotomously branched throughout, without proliferous branches, attached by rhizoids; apices straight to slightly incurved; internodal cells cylindrical, with short conical ends, 30-40  $\mu$  in diam. below, 24-28  $\mu$  above, 4-6 times as long as broad; corticating bands very narrow, composed of two or sometimes three rows of rounded cells, the larger ones below; tetrasporangia prominent, naked, solitary and secund at the nodes, or occasionally whorled, 30-40  $\mu$  in diam. including the thick, hyaline envelope; sexual plants not seen.

TYPE: H. L. Mason 36, April, in Herb. California Academy of Sciences (173642). An isotype slide is in Herb. A. Hancock Foundation.

TYPE LOCALITY: Epiphytic on *Codium*, Isla Guadalupe, Baja California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8522, Isla Guadalupe, on *Codium*. *Gulf of Calif.*—D. 286a-40, Puerto Refugio, Isla Ángel de la Guarda.

***Ceramium affine* var. *peninsularis* Dawson**

Pl. 17, fig. 9-10

Dawson 1950, p. 132, pl. 2, fig. 16-17.

Like the type of the species but twice the size in all vegetative dimensions, 60-70  $\mu$  in diam.; tetrasporangia about 40  $\mu$  in diam.

TYPE: W. Williams, April 27, 1946, in Herb. A. Hancock Foundation.

TYPE LOCALITY: Dredged from 4-6 m. depth, Isla Concha, Laguna de Scammon, Baja California.

MEXICAN DISTRIBUTION: *Baja Calif.*—Williams, May 1946, Laguna de Scammon; D. 6892, Punta Frailes.

***Ceramium californicum* J. Ag.**

Pl. 20, fig. 4

J. Agardh 1894, p. 45; Dawson 1950, p. 123, pl. 3, fig. 18; Dawson 1945, p. 62, misidentified as *C. evermannii*.

Thalli 2-3 cm. high or more, attached by a disc supplemented by rhizoids, 400-600  $\mu$  in diameter in the lower parts, openly dichotomously branched below with frequent proliferous branchlets, more densely branched above; axes gradually reduced to somewhat forcipate tips, corticated only at the nodes above, the bands 0.5-0.7 times as high as wide, of small, irregular angular cells, truncate above and below, the bands in lower parts extending themselves by acropetal and basipetal secondary growth; tetrasporangia prominently emergent, at first adaxial, later tending to be whorled, the fertile cortical bands little distorted; spermatangia covering more or less completely the inner cortical bands of upper branches; cystocarps not seen.

TYPE: No. 31 of Farlow, Anderson and Eaton, *Algae Exsiccatae*

Americae Borealis, copy in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: Coast of California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 5164, 5183, 6494, Cabo Colnett; D. 1167, 1213, Punta Baja; D. 1510, Punta Santa Rosalía; D. 9138, Bahía Asunción; D. 9509, Punta Abreojos; D. 6711, Bahía Magdalena.

***Ceramium camouii* Daws.**

Pl. 17, fig. 8; Pl. 18, fig. 1-2

Dawson 1944, p. 319, pl. 51, fig. 2-3; Dawson 1950, p. 129; Dawson 1957a, p. 8.

Thalli 3-4 mm. high, sparingly dichotomously branched, with occasional secondary lateral branches, 30-40  $\mu$  in diam., corticated only at the nodes; apices not forcipate, with a conspicuous terminal cell, with many slender, early-deciduous hairs; cortical bands separating early, usually conspicuously tumid, composed of 2-3 rows of cells, the internodes soon reaching 100-150  $\mu$  long; tetrasporangia in whorls, emergent from open, hemispherical, tumid, cortical involucre about 125  $\mu$  broad; sexual plants not seen.

TYPE: E. Y. Dawson 737-40, July 18, 1940, in Herb. A. Hancock Foundation (55).

TYPE LOCALITY: Among other minute algae scraped from littoral rocks, Isla Turner off Isla Tiburón, Gulf of California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Hollenberg 2545, Bahía de Todos Santos near Punta Banda; D. 16171 (Limbaugh) Rocas Alijos, *Gulf of Calif.*—D. 1751, Bahía Bocochoibampo, entangled with *Centroceras*; D. 3467, La Paz, entangled with *Polysiphonia*.

***Ceramium caudatum* Setch. & Gard.**

Pl. 19, fig. 7, Pl. 20, fig. 1

Setchell & Gardner 1924, p. 776, pl. 27, fig. 55-57; Dawson 1944, p. 317; Dawson 1950, p. 134; Dawson 1959, p. 30. *Ceramium avalonae* Dawson 1949, p. 17, pl. 5, fig. 31, pl. 14, fig. 56; Dawson 1950, p. 133, pl. 3, fig. 25-26.

Thalli minute, creeping or entangled among other algae, (2) 4-12 (15) mm. high, attached by rhizoids from the nodes, 70-100  $\mu$  in diam., or in some forms 180-200  $\mu$  in diam. at lower nodes and reduced above; filaments corticated only at the nodes; apices forcipate; internodes 20-30  $\mu$  long above, 80-300  $\mu$  long below (1.5-2.5 diameters); nodal bands projecting only slightly, consisting in younger parts of larger, rounded, downwardly directed cells in lower parts of band and smaller, angular cells in upper part, the angular cells in older bands tending to extend down over the larger, rounded cells; tetrasporangia commonly caudate, especially in young stages, or ovoid at maturity, 55-70  $\mu$  in diam., projecting, naked, abaxial, 1 or a few at a node; cystocarps subterminal, about 120  $\mu$  in diam., surrounded by long, overarching branchlets; spermatangia not seen.



TYPE: Marchant 48b, May, in Herb. University of California, Berkeley.

TYPE LOCALITY: Floating among other algae, Eureka, near La Paz.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Hubbs 12/7/46, D. 8524, Isla Guadalupe; D. 8792, Bahía San Quintín. *Gulf of Calif.*—D. 3480, Bahía Empalme; D. 857, Isla Jorge; D. 10991, 10988, Bahía de San Francisco; D. 18780, D. 18769, Puerto Escondido; D. 10894, Bahía Topolobampo.

This is apparently a species of infrequent occurrence and has been confused and redescribed as *C. avalonae* from southern California because of the disjunct distribution and variation of the cortical-band morphology between younger, smaller and more luxuriant plants. The abaxial, usually caudate tetrasporangia and the pendant appearance of the larger, lower cells of younger cortical bands are distinctive. The Setchell & Gardner illustrations of the cortical bands of the type were not accurately drawn and do not indicate the distinctive cell arrangements.

***Ceramium clarionense* Setch. & Gard.**

Pl. 18, fig. 5-6

Setchell & Gardner 1930, p. 170, pl. 7, fig. 25-27; Dawson 1950, p. 134, pl. 4, fig. 29; Dawson 1957, p. 8.

Thalli to 1 cm. high, partially creeping and attached multicellular rhizoids, often producing a green iridescence in life; erect parts 160-250  $\mu$  in diam., regularly dichotomously branched with strongly circinate apices; cells of central axis slightly longer than broad below, diminishing in length upward; cortication of variable extent, the internodes sometimes so narrow above as to be little more than lines, commonly 40-60  $\mu$  above, lengthening to 150-200  $\mu$  below; cortical bands usually a little more than 1/2 as long as wide, truncate above and below, sometimes becoming tumid in lower parts, consisting of a central inner row of rotund cells 15-18  $\mu$  in diameter and an outer layer of irregularly arranged, more or less angular cells mostly about 10  $\mu$  in maximum dimension, provided, external to the cortical cells, with small, deeply staining globules ("gland cells") and sometimes also with short hairs; tetrasporangia numerous, emergent, usually naked, scattered adaxially or all the way around the node without cortical modification; spermatangia surrounding the nodes, 1.5  $\mu$  in diameter; cystocarps borne in the axils of the dichotomies, naked, variously lobed.

TYPE: H. L. Mason, 75, June, in Herb. California Academy of Sciences (173620)

TYPE LOCALITY: Growing on *Codium*, Isla Clarión, Revillagigedo Arch., Mexico

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8609, 8377, Isla Guadalupe; D. 1393, Desembarcadero de Miller; Williams 5/14/46,



Isla Cedros; Williams 4/30/46, Laguna de Scammon; D. 16185a (Limbaugh), Rocas Alijos; D. 13382, Bahía de Santa María, Isla Magdalena. *Gulf of Calif.*—D. 679, Puerto Liberated; D. 850, Isla Jorge; D. 745, Isla Patos; D. 1018a, Isla Partida; D. 612a, Ensenada de San Francisco; D. 7028, Isla Espíritu Santo; D. 6800, Cabeza Ballena near San Lucas; D. 10964, 10944, 10909, Bahía Topolobampo. *Nayarit*—D. 3696, Mira Mar. *Oaxaca*—D. 10764, 10767, Salina Cruz.

***Ceramium codicola* J. Ag.**

Pl. 19, fig. 5-6, Pl. 20, fig. 5

J. Agardh 1894, p. 23; Dawson 1950, p. 117, pl. 1, fig. 6. *Ceramium codiophila* Setchell & Gardner 1937, p. 89, pl. 8, fig. 23-24; Dawson 1944, p. 318 (in part); Dawson 1945a, p. 25; Dawson 1951, p. 53.

Thalli epiphytic on *Codium*, usually 1.0-2.4 cm. tall, consisting of a tuft of irregularly dichotomous axes from a basal mass of penetrating, pigmented rhizoids with inflated, bulbous tips; axes completely corticated, with inconspicuous differentiation of cortication tissue between nodal and internodal portions, the axial diameters tending to be greatest in mid-parts, the tips somewhat forcipate; short proliferous branchlets often frequent; tetrasporangia completely embedded in more or less swollen fertile axes, scattered or whorled, spherical, 35-40  $\mu$  in diam.; cystocarps borne at the last two or three dichotomies of branches, surrounded by involucrel branchlets; spermatangia not seen.

TYPE: Not designated, but probably an Anderson collection in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: Santa Cruz, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8130, H. W. Clark 229 (type of *C. codiophila*), Isla Guadalupe; D. 8864, Punta Baja; D. 2838, Punta Santa Rosalía; D. 10508, Punta Norte, Isla Cedros; Howell 20b, Bahía San Bartolomé; D. 9083, Islas San Benito.

***Ceramium eatonianum* (Farl.) De Toni**

Pl. 19, fig. 1-2

De Toni 1903, p. 1493; Dawson 1950, p. 117; Dawson 1945, p. 62-67; Taylor, 1945, p. 271; Dawson 1949, p. 223; Dawson 1950b, p. 68; Dawson 1951, p. 53. *Centroceras eatonianum* Farlow 1875, p. 373.

Thalli 1-4 (10) cm. tall, purplish-black, dichotomously branched but appearing as if distichously pinnate, the branches  $\pm$  divergent at angles of 20-40°, acute, non-forcipate, without short proliferous branchlets; axes completely corticated, somewhat constricted at the nodes, the internodal corticating cells tending to be in vertical rows; nodal portion of corticating tissue with gland cells; tetrasporangia completely immersed in the cortex; cystocarps lateral, subhemispherical, 350-550  $\mu$  diam., without involucrel branches (modified from Smith).

TYPE: Evidently represented by a collection by E. Hall in the Farlow Herbarium, Harvard University.

TYPE LOCALITY: "West Coast" of U.S., but not specifically indicated. De Toni's indication would suggest that it is Oregon.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 77-45, Punta Descanso; D. 13-45, Cabo Colnett; Taylor, 34-648, Isla Cedros; D. 1142, 1298, 8702, 8883, Punta Baja; D. 1379, Desembarcadero de Miller; D. 1426, 1513, 2918, Punta Santa Rosalía; D. 7267, 13418, Isla Magdalena.

***Ceramium equisetoides* Daws.**

Pl. 19, fig. 4

Dawson 1944, p. 320, pl. 51, fig. 1; Dawson 1950, p. 128.

Thalli 8-15 mm. high, 80-100  $\mu$  in diam., primarily dichotomously branched, the young sterile apices usually forcipate, with frequent secondary monopodial branches, corticated only at the nodes; cortical bands 0.5-0.75 times as long as wide, non-tumid, truncate above and below, composed of a row of larger, median sub-surface cells and a surface layer of irregularly arranged angular cells mostly under 10  $\mu$  in maximum diameter; internodes very short above, reaching 200  $\mu$  in the lowermost parts; tetrasporangia immersed in swollen terminal portions of the main or lateral branches which are non-forcipate, usually a single whorl at each node; shorter lateral tetrasporangial branches resembling the strobili of *Equisetum*; spermatangia completely covering terminal ramuli, or, if internodes are early elongate, in verticillate tufts; cystocarps unknown.

TYPE: E. Y. Dawson 479-40, January 1940, in Herb. A. Hancock Foundation (56).

TYPE LOCALITY: Puerto San Carlos, near Guaymas, Sonora, Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 7206, 7238, Bahía San Francisco, near Guaymas; D. 21697, Bahía Empalme; D. 6931, near La Paz.

In the absence of adequate material of *C. templetonii* S. & G. from the Galapagos Islands it is not clear how these two species differ. The tetrasporangial axes in *C. templetonii* appear to become swollen well below the forcipate tips, while those of *C. equisetoides* are terminally swollen to acute tips. However, a specimen from Bahía Agua Dulce, D. 911, appears to agree with *C. templetonii* in its tetrasporangial branches, but otherwise with *C. equisetoides*. Further collections in both the Gulf of California and the Galapagos Islands are needed.

***Ceramium evermannii* Setch. & Gard.**

Pl. 21, fig. 3-4

Setchell & Gardner 1930, p. 169, pl. 8, fig. 28-29; Dawson 1950, p. 123.

Thalli 4-6 cm. high, flaccid, 390-410  $\mu$  in diam. in the basal region; main branches dichotomous, arising by longitudinal splitting of the apical cell, with numerous proliferous branches of limited growth

arising from the large nodal cells; apices forcipate and much incurved; cells of the axial filament 1.5-2.0 times as long as broad below, slightly swollen at the end; corticating bands at the nodes wide, covering about  $3/4$  of each internode below, almost completely covering these in the ultimate ramuli; corticating bands asymmetrical with respect to the nodes, considerably more than half being below and composed of close-fitting, approximately isodiametric cells forming about four fairly well-defined whorls, while the upper part of the band is composed of cells which elongate vertically and are without definite arrangement in whorls; trichoblasts long, numerous, bulbous at the apices when young; tetrasporangia immersed within the band, arising on all sides, 55-65  $\mu$  in diam.; cystocarps and spermatangia unknown (after Setchell & Gardner).

TYPE: H. L. Mason 82, April, in Herb. California Academy of Sciences (173621).

TYPE LOCALITY: Among other small algae, Guadalupe Island, Mexico.

MEXICAN DISTRIBUTION: Known only from the type.

***Ceramium fimbriatum* Setch. & Gard.**

Pl. 19, fig. 3; Pl. 20, fig. 6-7

Setchell & Gardner 1924, p. 777, pl. 26, fig. 43-44; Setchell & Gardner 1937, p. 88, pl. 7, fig. 18; Dawson 1944, p. 317; Dawson 1950, p. 123; Dawson 1951, p. 54; Dawson 1959, p. 30.

Thalli minute, partially creeping or entangled, to 1 cm. in extent, the filaments 80-100  $\mu$  in diam., regularly dichotomous, corticated only at the nodes, the lower, or prostrate parts provided with numerous rhizoids from the nodes; cortical bands about  $1/2$  as long as wide, divided by a clear line in the lower third into two parts, composed of irregularly angular cells, provided with a whorl of short, thick, deciduous or semi-permanent hairs 40-50  $\mu$  long, 20-25  $\mu$  in diam.; internodes 25-30  $\mu$  long above, rapidly lengthening to 300-400  $\mu$  below; apices forcipate; tetrasporangia spherical, 55-65  $\mu$  in diam., whorled within swollen cortical involucre; sexual plants not known.

TYPE: Marchant 87a, May, in Herb. University of California, Berkeley.

TYPE LOCALITY: Floating, Eureka, near La Paz, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Hollenberg 2571, Punta Banda; D. 1407, Punta Santa Rosalía; Williams 4/24/46, Laguna de Scammon; D. 10502, 12 mi. east of Punta Eugenio. *Gulf of Calif.*—D. 202-40, Puerto Refugio, Isla Angel de la Guarda; D. 160-40, Isla Tiburón; D. 413a-40, Isla Pond; D. 753-40, Isla Turner; D. 10987, Ensenada de San Francisco; D. 18765, Puerto Escondido;



D. 18811, Isla Monserrate; D. 561b-40, Bahía Agua Verde; D. 565b-40, Isla Espíritu Santo; Johnston 618b, San Jose del Cabo, 40 m.; D. 10936, Bahía Topolobampo; D. 6826, Cabeza Ballena, near San Lucas; D. 3596, Mazatlán. *Guerrero*—D. 3842a (Hubbs), Acapulco.

This species is closely related to the group of plants, including *Ceramium recticorticum*. *C. gracillimum* var. *byssoides* and *C. taylorii*, in which the tetrasporangia are whorled and involucrate and in which the cortical band is divided at about the lower third into two distinct parts. In *C. fimbriatum* the cells of this lower cortical part are often horizontally elongated.

***Ceramium gracillimum* var. *byssoides* (Harv.) G. Mazoyer**

Pl. 20, fig. 2-3; Pl. 21, fig. 2-3

G. Mazoyer 1938, p. 323; Dawson 1956, p. 53; Dawson 1959, p. 30 *Ceramium byssoides* Harvey 1853, p. 218. *Ceramium masonii* Dawson 1950, p. 126, pl. 2, fig. 11-12. *Ceramium transversale* Collins & Harvey 1917, p. 145, pl. 5, fig. 29-31; Setchell & Gardner 1930, p. 170, pl. 7, fig. 23, 24. *Ceramium gracillimum* as interpreted by Dawson 1944, p. 319.

Thalli epiphytic, attached by rhizoids from the nodes of semi-prostrate or entangled lower filaments, to 4-5 (or 10) mm. high, 40-50  $\mu$  in diam., above, 60-80  $\mu$  in diam. below, corticated only at the nodes, without secondary cortical expansion; branching apparently alternate, the apices non-forcipate, slightly incurved; internodes long below, to 5 times the nodal diameter; cortical bands divided in their lower third by a clear line, consisting in the upper two thirds of larger, angular cells cutting off a few smaller, superficial cells, the lower third of 1-2 tiers of horizontally elongated cells, sometimes provided with  $\pm$  abundant gland cells; tetrasporangia solitary to whorled, borne within the cortical band which is modified by their growth to form an involucre; spermatangia in whorled tufts at the nodes.

TYPE: A collection by W. H. Harvey epiphytic on "gorgoniae," probably in the Harvey Herbarium, Dublin, Ireland.

TYPE LOCALITY: Key West, Florida

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8511, 8525, Hubbs 46-144, Mason 83, Isla Guadalupe; Williams 5/14/46, Isla Cedros; D. 6631, Isla Margarita. *Gulf of Calif.*—D. 11019, Bahía San Carlos; D. 470, Bahía Bocochoibampo; D. 3518, Ensenada de San Francisco; D. 6730, Punta Frailes; D. 3166, near Cabo Pulmo; D. 3442, 3417, La Paz; D. 6756, 6770, Cabeza Ballena. *Guerrero*—D. 3879, Acapulco.

***Ceramium hamatispinum* Daws.**

Pl. 22, fig. 2-4

Dawson 1950, p. 122, pl. 3, fig. 20-22.

Thalli forming entangled masses amid small, mat-dwelling algae, the filaments 90-130  $\mu$  in diam., or 50-70  $\mu$  in young parts, irregularly



and distantly dichotomously, divergently branched, corticated only at the nodes; apices circinate; nodal cortex 40-60  $\mu$  long, of irregularly arranged, small angular cells, bearing a whorl of 5-6, usually 3-celled, non-deciduous, stout spines 30-50  $\mu$  long with sharp, usually hooked tips, the hook directed basally; internodes elongating early, becoming 100-250  $\mu$  long in older filament parts; nodes occasionally with slender, accessory rhizoids; secondary cortical expansion essentially absent; reproduction not seen.

TYPE: E. Y. Dawson 3706, December 20, 1946, in Herb. A. Hancock Foundation

TYPE LOCALITY: Intertidal, Mira Mar, south of San Blas, Nayarit.

MEXICAN DISTRIBUTION: *Nayarit*—D. 10874, Mira Mar.

***Ceramium horridum* Setch. & Gard.**

Pl. 23, fig. 4

Setchell & Gardner 1924, p. 777, pl. 26, fig. 49-50, pl. 79; Dawson 1944, p. 318; Dawson 1950, p. 116.

Thalli 6-8 cm. high, completely corticated throughout, dichotomously branched, the branches gradually attenuated from about 500  $\mu$  in the lower parts, the tips at first forcipate, ultimately terminating in divaricate, unicellular spines, such spines also terminating short lateral branchlets; lower parts more or less abundantly provided with short lateral branchlets tending to be whorled at the nodes; cortical cells angular, tending to be arranged in longitudinal rows; tetrasporangia immersed without definite order in fertile bands at the nodes of main axes and of short lateral branchlets, about 30  $\mu$  in diameter; sexual plants not seen.

TYPE: Marchant 91, May, in Herb. University of California, Berkeley.

TYPE LOCALITY: Cast ashore, Guaymas, Sonora, Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 256-40, Puerto Refugio, 12-22 m.; D. 427-40, 430-40 Isla Pond; D. 143-40 Isla Tiburón, 4-32 m.; D. 6965 (AHF Sta. 526-30) Los Mangles, Isla Carmén; D. 6926 Isla Espíritu Santo.

***Ceramium howellii* Setch. & Gard.**

Pl. 21, fig. 1; Pl. 22, fig. 1

Setchell & Gardner 1937, p. 88, pl. 6, fig. 14.

Thalli up to 15 mm. high, 180-350  $\mu$  in diam., attached by rhizoids, partly prostrate and partly erect, with relatively sparse secund branching from the prostrate filaments, with irregularly alternate, sparse, mostly short branches from the erect filaments; growing apices tending to be adaxially curved to hooked, narrowly tapered; axes completely corticated throughout with no superficial indication of nodes; corticating cells

$\pm$  angular, (4)-7-12  $\mu$  in diam., without definite arrangement, essentially in a single layer; central filament of large, cylindrical cells tending to be shorter than broad; tetrasporangia completely embedded, numerous, irregularly scattered but aggregated in  $\pm$  distinct bands corresponding with the nodes of both main and lateral branches, the fertile axes to 600  $\mu$  in diam; spermatangia covering upper part of the thallus; cystocarps lateral, surrounded by several clasping involucrel branches (modified from Setchell & Gardner).

TYPE: J. T. Howell 379, June 2, in Herb. California Academy of Sciences (236527).

TYPE LOCALITY: On rocks, southeast side of Narborough Island, Galapagos Archipelago.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8266 (65-75 m.), D. 8425 (45-55 m.) Isla Guadalupe. *Gulf of Calif.*—D. 6992, Bahía Salinas, Isla Carmén (2-30 m.).

These specimens, though sterile, are somewhat larger and more luxuriant than the type, but otherwise correspond well with the Galapagos material. Setchell and Gardner describe the tetrasporangia as without definite order in somewhat swollen lateral branchlets. In the luxuriant Bahía Salinas specimen the tetrasporangia are embedded at the nodes in both main and lateral branchlets, forming fairly distinct bands, but irregularly scattered within the bands.

### *Ceramium mazatlanense* Daws.

Pl. 23, fig. 1-2

Dawson 1950, p. 130, pl. 2, fig. 14-15; Dawson 1954a, p. 6.

Thalli epiphytic, 3-4 mm. (up to 1 cm.) high, attached by rhizoids from the ventral surface of a prostrate, basal part of a filament; erect filaments 90-100 (150)  $\mu$  in diam., rather irregularly dichotomously branched, corticated only at the nodes, without secondary cortical expansion; apices forcipate, sometimes circinate; cortical band very short, 25-30  $\mu$  long, consisting of angular cells 7-25  $\mu$  in greatest diam., the largest below and beneath, often bearing numerous fine hairs; internodes elongated below, sometimes to 200  $\mu$ ; tetrasporangia borne in prominently projecting, abaxial, second cortical involucres, solitary or in groups of 2-3 at the nodes, sometimes later whorled and the tumid nodes appearing catenate, about 35  $\mu$  in diam.; spermatangia in low, adaxial and abaxial pulvinate masses at the nodes, later partially or completely encircling them; cystocarps not seen.

TYPE: E. Y. Dawson 3606, Dec. 8, 1946, in Herb. A. Hancock Foundation (48798).

TYPE LOCALITY: Epiphytic on *Codium*. Mazatlán, Sinaloa, Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 657-40, near Kino; D.

11031-11033, Ensenada de San Francisco. *Revillagigedo Arch.*—D. 12049, Isla San Benedicto. *Oaxaca*—D. 3815, 3819, Salina Cruz.

This species has been reported from Viêt Nam and from several localities in the central Pacific. The material from Ensenada de San Francisco is luxuriant and is the first to show the ultimate development of the whorled tetrasporangia in the tumid nodes after an initially abaxial development.

There is considerable resemblance between our plants and Easter Island material assigned by H. E. Petersen to *Ceramium cruciatum* Col. & Herv. (Børgesen 1924, p. 297, fig. 37).

***Ceramium obesum* Daws.**

Pl. 22, fig. 5-6

Dawson 1950, p. 119, pl. 1, fig. 7-9.

Thalli prostrate, creeping, growing over themselves and other small algae and debris, attaching by masses of small rhizoids produced from all contacting surfaces, very coarse, cylindrical, 900-1100  $\mu$  in diam., with axes 20-22 mm. long, completely corticated throughout, abruptly reduced at the apices to short, coarse, strongly forcipate tips; primary branching dichotomous, infrequent; secondary branching irregular, frequent, consisting mostly of very short branchlets with strongly incurved tips; cortex very thick, completely covering the axes, consisting of an inner layer of thick-walled rotund cells 25-100  $\mu$  in diam. adjoining the central axial cells which are about 400  $\mu$  in diam., and an outer layer of densely packed small anticlinally elongated cells 15-25  $\mu$  long by 5-9  $\mu$  wide; reproduction not seen.

TYPE: E. Y. Dawson 964, Feb. 21, 1946, in Herb. A. Hancock Foundation (5279).

TYPE LOCALITY: Intertidal rocky shore, Bahía Agua Dulce, Isla Tiburón, Sonora, Mexico.

***Ceramium ornatum* Setchell & Gardner**

Pl. 24, fig. 2

Setchell & Gardner 1930, p. 172; Dawson 1950, p. 137, pl. 2, fig. 10.

"Fronds approximately 4 cm. high, the main axes approximately [300-450]  $\mu$  in diam., sparsely and dichotomously branched with occasional proliferous ramuli and all tapering gradually toward the apices, slightly swollen at the nodes; cells of the axial filament cylindrical, 1-1.5 times as long as broad; nodal band extending beyond the surface of the axial filament, relatively narrow, equally distributed above the node, composed of one whorl of deep-seated, large cells cutting off above and below usually one whorl each of smaller, more or less globular cells, these in turn giving rise to numerous, small, angular, surface cells, irregularly placed and giving rise to numerous, long, narrow,

4-5  $\mu$  diam., trichoblasts; tetrasporangia beginning to form near the base of the main filament and extending throughout the entire system of branches to the ultimate ramuli, scattered more or less all the way around the filament at the nodes, but mostly in two groups on opposite sides of the filament, naked, projecting upward from the upper half of the band, not subtended by bracteate filaments, 60-65  $\mu$  wide, 80-90  $\mu$  long; cystocarps and antheridia unknown." (after Setchell & Gardner)

TYPE: H. L. Mason 191, April, in Herb. California Academy of Sciences, (173632). An isotype slide is in Herb. A. Hancock Foundation.

TYPE LOCALITY: Growing on Eel Grass cast ashore at Isla Guadalupe, Baja California, Mexico.

"A much more robust plant than either *C. caudatum* S. & G. from the Gulf of California or *C. personatum* . . . The cortical bands are much more complex . . ."

### *Ceramium pacificum* (Collins) Kylin

Pl. 23, fig. 3; Pl. 24, fig. 1

Kylin 1925, p. 61; Dawson 1945, p. 67; Dawson 1950, p. 120, pl. 4, fig. 30; Dawson, Neushul & Wildman 1960, p. 50, pl. 37, fig. 1-2. *Ceramium rubrum* var. *pacificum* Collins, in Collins, Holden & Setchell, Phyc. Bor. Amer. no. 893, 1747.

Thalli 5-7 (up to 18) cm. tall, deep red, the branching dichotomous and with a divergence of 50-80°, the ultimate dichotomies less widely divergent and forcipate, completely corticated throughout; branches beset with numerous simple or forked proliferous branchlets most of which are less than 5 mm. in length; differentiation of nodal and internodal portions of corticating tissue indistinct; tetrasporangia immersed, irregularly distributed; cystocarps borne at the last two or three forkings of branches, surrounded by involucrel branchlets (modified from Smith).

TYPE: Not specifically designated, but represented by syntypes distributed as no. 893 in Phycotheca Boreali Americana.

TYPE LOCALITY: Monterey, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*— D. 1509, 1610, 1557, just south of Punta María, in drift.

### *Ceramium paniculatum* Okam.

Pl. 23, fig. 5-7

Okamura 1921, p. 114, pl. 179, fig. 8-16; Dawson 1944, p. 319; Dawson 1950, p. 122; Dawson 1959, p. 10.

Thalli 8-12 mm. high, the filaments about 150  $\mu$  in diam., little reduced except at the very tips, regularly dichotomously branched with few proliferous branchlets, corticated only at the nodes; cortical bands truncate above and below, mostly 1.5 times as wide as high, of angular cells, the larger ones in the center; internodes very short



above (15-20  $\mu$ ) gradually lengthening to about 100 (200)  $\mu$ ; apices forcipate, provided abaxially with a series of sharp, 3-4-celled, straight or recurved, partially deciduous spines, 30-50  $\mu$  long; tetrasporangia abaxial, tending to become whorled, involucrate by bracteate filaments, prominent, causing the nodal band to appear tumid, ovoid, about 40  $\mu$  in diam.; spermatangia in low, pulvinate, mostly adaxial masses at nodes; cystocarpic plants not seen.

TYPE: A collection by M. K. Nemoto in the Okamura Herbarium, Faculty of Sciences, Hokkaido University, Sapporo, Japan.

TYPE LOCALITY: Kamahara, Iwaki Province, Japan.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8544, Isla Guadalupe (This plant exhibits exceptionally long spines (110  $\mu$ ) of 5 cells plus 1 or 2 small lateral cells at the base; they are straight and occasionally forked, not particularly seriate and usually persistent.) *Gulf of Calif.*—D. 18578-9, Isla San Pedro Nolasco; D. 1980, 3522, Drouet & Richards 3408, vic. of Guaymas; D. 3237, Punta Palmilla; D. 6810, Cabeza Ballena; D. 3637, Mazatlán. *Oaxaca*—D. 10752, Salina Cruz.

### *Ceramium personatum* Setch. & Gard.

Pl. 29, fig. 3-4

Setchell & Gardner, 1930, p. 171, pl. 6, fig. 21-22; Dawson 1950 p. 133.

Thalli 8-15 mm. high, 110-120  $\mu$  in diam. below, diminishing gradually toward the apices; branching dichotomous, the tips slightly incurved, corticated only at the nodes, the nodal bands narrow, about 1/2 as high as wide or less, slightly higher in lower segments than upper, very slightly projecting beyond the internodal cells, with even margins above and below, with large cells below and smaller ones above the center, some of the larger cells in older parts giving rise to descending pluricellular rhizoidal appendages against the internodal cell walls; internodes shorter above, 2 times the breadth below; tetrasporangia projecting, somewhat immersed or fully naked, at first abaxial, 1-2 at a node, later whorled and somewhat involucrate, 75-85  $\mu$  long, somewhat caudate; spermatangia in adaxial, pulvinate tufts at the nodes, tending to become whorled; cystocarps unknown.

TYPE: H. L. Mason 83, April, in Herb. California Academy of Sciences (173622)

TYPE LOCALITY: Epiphytic, Isla Guadalupe, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 13453 Bahía Magdalena.

Setchell and Gardner recognized certain similarities between this plant and their earlier described *C. caudatum*. I have noted this also and suggest that *C. personatum* may ultimately prove to be a variant of *C. caudatum*. The pluricellular rhizoidal appendages are conspicuous

when present and have been observed in three other collections whose proliferous branching and tumid older fertile nodal characters, however, make their identity unclear: Dawson 1511, Punta Santa Rosalía; D. 1575, 1594 Bahía Ositos, near Punta María.

***Ceramium procumbens* Setch. & Gard.**

Pl. 24, fig. 3-4; Pl. 25, fig. 1-3

Setchell & Gardner 1924, p. 772, pl. 27, fig. 51-54; Dawson 1944, p. 318; Dawson 1950, p. 128; Dawson 1959, p. 30.

Thalli microscopic, the primary axes prostrate, attached to the host by short rhizoids, 1-3 mm. in extent; primary axes 45-90  $\mu$  in diam., distichously branched, the ramuli at first parallel with the host, often opposite, later somewhat erect and sparingly dichotomously branched; cortication only at the nodes; tetrasporangial ramuli short, clavate; tetrasporangia completely immersed, irregularly placed, 40  $\mu$  broad, 50  $\mu$  long; cystocarps single or rarely 2-3 together, short-pedicellate, spherical, 50-60  $\mu$  in diam., arising near the ends of the ramuli, the main ramulus being pushed aside and 1-3 very short ramuli developing around them; spermatangia developing from a broad, swollen region on short, specialized ramuli.

TYPE: Ivan M. Johnston 27a, July, in Herb. California Academy of Sciences (1364).

TYPE LOCALITY: Epiphytic on *Grateloupia prolongata*, Isla Partida, Gulf of California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 2763, 2800, Punta Santa Rosalía, *Gulf of Calif.*—D. 1323, Bahía de Los Angeles; D. 1816, Ensenada de San Francisco; D. 10992, Bahía San Carlos; D. 18653, Isla Tortuga; D. 18726, 18728, Isla Ildefonso; D. 18785, Puerto Escondido; D. 18865, Bahía Agua Verde.

***Ceramium recticorticum* Daws.**

Pl. 24, fig. 5-6

Dawson 1950, p. 124, pl. 3, fig. 23-24.

Thalli epiphytic, 1.5-3.0 mm high, often densely tufted, attached to the host by prostrate, basal parts of filaments bearing long rhizoids; branching apparently alternate; filaments 50-60  $\mu$  in diam. above, with non-forcipate, slightly incurved apices, corticate only at the nodes; cortical bands about 2/3 as long as broad, slightly tumid, consisting, except at the upper margin, of more or less rectangular cells horizontally elongated and arranged in about four definite horizontal and vertical rows, these regular rows maintained and usually unmodified by growth of enlargement below; internodes scarcely evident in uppermost 500  $\mu$  of branch tips, lengthening to 10-30  $\mu$  at somewhat lower levels, and then elongating markedly to 300-400  $\mu$  in the entangled, basal filaments from which verticils of rhizoids arise at the nodes; tetraspor-

angia 20-25  $\mu$  in diam., maturing within 300  $\mu$  of apex of terminal branches, borne in whorls of 3-5 (mostly 4) within the cortical band which is modified by their expansion to form an involucre; cystocarps and spermatangia unknown.

TYPE: E. Y. Dawson 1769, May 16, 1946, in Herb. A. Hancock Foundation (48795).

TYPE LOCALITY: Growing on *Coeloseira pacifica*, Bahía Bococho-bampo, near Guaymas, Sonora, Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 501, 509, 455a, 1706, 1749, 1772, 3566, Bahía Bococho-bampo, Sonora, on various hosts; D. 3667, Mazatlán, Sinaloa.

### *Ceramium serpens* Setch. & Gard.

Pl. 25, fig. 6

Setchell & Gardner 1924, p. 775, pl. 27, fig. 58; Dawson 1944, p. 318, Dawson 1949, p. 244; Dawson 1950, p. 129.

Thallus microscopic, epiphytic, the lower filaments creeping, 30-40  $\mu$  in diam. at the nodes, attached by short rhizoids arising singly at the nodes, sparsely forking, giving rise to a few sparsely branched erect axes 3-4 mm. (up to 10 mm.) high; cortication only at the nodes, the internodes naked and equal to or up to 4 times as long as the nodes; tetrasporangia usually solitary at the nodes, spherical, 20-25 (to 40)  $\mu$  in diam., extruding through the cortex; sexual plants unknown.

TYPE: Marchant 67c, May, in Herb. University of California. Berkeley.

TYPE LOCALITY: Epiphytic on *Laurencia*, La Paz, Baja California.

MEXICAN DISTRIBUTION: *Southern Baja Calif.*—D. 3132, La Paz; D. 3264, Punta Palmilla.

This species is also reported from the Marshall Islands.

### *Ceramium sinicola* Setch. & Gard. var. *sinicola*

Pl. 25, fig. 4-5; Pl. 27, fig. 6-7

Setchell & Gardner 1924, p. 773, pl. 25, fig. 40-41, pl. 75; Dawson 1944, p. 315; Dawson 1950, p. 118, pl. 1, fig. 4-5; Dawson 1957, p. 5, 8; Dawson 1959, p. 30. *Ceramium bicornne* Setchell & Gardner 1924, p. 773, pl. 28, fig. 64, pl. 74. *Ceramium codicola*, as interpreted by Dawson 1944, p. 318 (in part); Dawson 1945, p. 67; Dawson 1949, p. 26.

Thalli epiphytic, 1-3 cm. high, attached by slender, branched, non-bulbous rhizoids of various lengths and depths of penetration depending upon the texture of the host; erect parts dichotomously branched, the forcipate apices long and blunt, completely corticated in upper parts, the more slender basal parts of axes showing prominent internodal spaces; corticating cells irregularly arranged, angular, 8-11  $\mu$  in diam.; mature apices commonly with 1-several short, straight, pluricellular spines, tetrasporangia completely immersed, whorled at the nodes, occupying several forks of the somewhat swollen terminal ramuli.



TYPE: Ivan M. Johnston 67b, April, in Herb. California Academy of Sciences (1366). An isotype slide is in Herb. A. Hancock Foundation.

TYPE LOCALITY: Ensenada Bay (Todos Santos Bay at Ensenada), Pacific Baja California. Note: This plant was originally named "*sinicola*" because of the mistaken supposition that "Ensenada Bay" was in the Gulf of California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 246, Punta Descanso; D. 1161, Punta Baja; D. 2953, Desembarcadero de Miller; D. 10388, 10461, vicinity of Punta San Eugenio; D. 16155 (Limbaugh) Rocas Alijos; D. 6707, Isla Magdalena; D. 6902, Cabeza Ballena. *Revillagigedo Arch.*—D. 4/17/55, Isla San Benedicto. *Gulf of Calif.*—Common on various hosts, commonly *Codium*. Many records from Bahía Tepoca to La Paz; D. 10946, Bahía Topolobampo.

***Ceramium sinicola* var. *interruptum*** (Setch. & Gard.) Daws.

Pl. 27, fig. 8

Dawson 1944, p. 316; Dawson 1950, p. 119; Dawson 1959, p. 30. *Ceramium interruptum* Setchell & Gardner 1924, p. 775, pl. 26, fig. 47.

Like the type of the species, but the generally continuous cortication of upper parts conspicuously interrupted by internodal spaces at the dichotomies.

TYPE: Marchant 78, May, in Herb. University of California, Berkeley. An isotype slide in Herb. A. Hancock Foundation.

TYPE LOCALITY: Epiphytic on other algae, Eureka, near La Paz, Baja California.

MEXICAN DISTRIBUTION: Same as the species.

***Ceramium sinicola* var. *johnstonii*** (Setch & Gard.) Daws.

Dawson 1944, p. 316; Dawson 1950, p. 119. *Ceramium johnstonii* Setchell & Gardner 1924, p. 774, pl. 76, 77.

Like the type of the species, but the cortication continuous throughout the plant except in extreme basal parts.

TYPE: Ivan M. Johnston 104, April, in Herb. California Academy of Sciences.

TYPE LOCALITY: Isla San Pedro Martir, Gulf of California.

MEXICAN DISTRIBUTION: Same as the species.

***Ceramium taylorii*** Daws.

Pl. 26, fig. 1-3

Dawson 1950, p. 127, pl. 2, fig. 13, pl. 4, fig. 31-33; Dawson 1954a, p. 6; Dawson 1959, p. 30, *Ceramium fastigiatum* prox. as interpreted by Taylor 1945, p. 271.

Thalli epiphytic or saxicolous, arising from prostrate filaments adhering by rhizoids from the ventral nodal surfaces, the erect parts to 5 (or to 16) mm. high, 60-80  $\mu$  in diam. above, to 180  $\mu$  in diam. below, apparently alternately branched; tips non-forcipate, divergent or some-



what incurred in youth; cortical bands somewhat tumid, about  $2/3$  as long as broad, separated by internodal spaces of  $40\ \mu$  or less above, but sometimes to  $150\ \mu$  below (or rarely to  $700\text{--}800\ \mu$  in unusual plants of lax habit), divided in the lower third into two parts by a clear line, the cells in the lower third often at first horizontally elongated, but ultimately divided into small, angular cells, the upper part of the band consisting of several larger, deep-seated cells cutting off smaller cells toward the top and outside of the band; tetrasporangia whorled, 2-6 at a node, about  $30\ \mu$  in diam., borne within the tumid upper  $2/3$  of the divided cortical band which becomes modified by their expansion to form an involucre; old branches bearing empty involucres appearing catenate; spermatangia borne in a more or less continuous superficial layer of terminal branches above the region of internodal elongation, tending to be confined to adaxial surface; cystocarps borne terminally, surrounded and completely overarched by 5-6 long, clasping, involucreal branches.

TYPE: E. Y. Dawson 3393, Nov. 9, 1946, in Herb. A. Hancock Foundation (48797).

TYPE LOCALITY: Cabeza Ballena near San Lucas, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 211a, Punta Descanso; D. 1644, near Punta María; D. 1576, 1587, Bahía Los Ositos; D. 2814, 1425, Punta Santa Rosalía; D. 10339, 10342, Punta Engenio; D. 6708, 7268, Isla Magdalena; *Gulf of Calif.*—D. 759, 786, 724, 800, Isla Patos; D. 1002, 1018, Isla Partida; D. 1039, Isla Raza; D. 613, 617, 1878, 1898, 1957, 1961, 1962, 1969, 1982, 3520, 11004, vic. of Guaymas; D. 7176, Puerto Escondido; D. 7051, Isla Carmén, D. 3320, 3342, 3368, 3401, Cabeza Ballena. *Sinaloa*—D. 3599, 3616, 3618, 3623, 3658, 3675, 10823, 10830, 10837, 10926, Mazatlán. *Nayarit*—D. 3704, Mira Mar. *Guerrero*—D. 3878, 3899, Acapulco; Taylor 34-581, Bahía Petatlán; Taylor 39-627, White Friars Isl. *Oaxaca*—D. 10764, Salina Cruz.

### *Ceramium vagabunde* Daws.

Pl. 27, fig. 5

Dawson 1957, p. 121, fig. 27e, Dawson 1954a, p. 6, pl. 4, fig. 2 (as *Ceramium* sp.)

Plants minute, 4-5 mm. high, growing among other tufted algae, consisting of a creeping semi-prostrate basal filament provided with numerous ventral rhizoids from the nodes, giving rise to irregularly and sparsely branched erect branches with blunt, non-forcipate tips; erect axes  $120\text{--}140\ \mu$  in diameter, incompletely corticated, the internodes bare for intervals of  $30\text{--}70\ \mu$  in the middle and lower parts; cortical bands 1.5-2.0 times as broad as tall, without secondary growth above or below, the margins even, especially the lower ones, truncate, consisting

of a narrow inner ring of larger cells and, on either side, of an outer ring or irregularly arranged small angular cells less than  $10\ \mu$  in maximum diameter; tetrasporangia cruciate, ovate, about  $40\ \mu$  in length, borne verticillately within prominently swollen involucre which develop acropetally from the closely juxtaposed distal nodal bands of the erect axes; terminal fertile areas to  $220\text{--}250\ \mu$  in diameter, resembling those of *Equisetum* in form.

TYPE: E. Y. Dawson 13620a, August 19, 1955, in Herb. Bernice P. Bishop Museum, Honolulu.

TYPE LOCALITY: Growing within tufts of *Ectocarpus breviarticulatus* near the margin of the seaward reef opposite EMBL, Parry Island, Eniwetok.

MEXICAN DISTRIBUTION: *Revillagigedo Arch.*—D. 12074, Isla San Benedicto. *Gulf of Calif.*—D. 735-40, Isla Turner off Isla Tiburón.

### ***Ceramium viscainoense* Daws.**

Pl. 27, fig. 1-2

Dawson 1950, p. 120, pl. 1, fig. 1-3.

Thallus 15-25 mm. high, tufted, saxicolous, attached by massed and coalesced short rhizoids which in mature plants form a spongy disc. consisting of several to many dichotomously branched axes arising from the base; older branches  $400\text{--}500\ \mu$  in diam., catenately constricted at the nodes, gradually reduced in diameter above and the constrictions less prominent; secondary proliferous branches multifarious, short, increasingly abundant and more congested above; ultimate branches divergent, non-forcipate, acute; cortex continuous throughout, primarily of irregularly disposed small angular cells and a few larger cells at the junction of the rotund axial cells, generally thin or incomplete over the bulging midparts of the central axial cells, the longitudinally arranged, small, mostly elongated cells of young segments becoming in part increasingly longer or even filamentous as secondary, acropetal and basipetal cortical growth progresses; tetrasporangia  $30\text{--}35\ \mu$  in diam., completely immersed in the cortex; cystocarps surrounded by 3-5 involucreal branchlets.

TYPE: E. Y. Dawson 1430, April 13, 1946, in Herb. A. Hancock Foundation (5225).

TYPE LOCALITY: Intertidal rocky shore, Punta Santa Rosalía, Baja California, Mexico.

MEXICAN DISTRIBUTION: Known only from the type.

### ***Ceramium zaca* Setch. & Gard.**

Pl. 26, fig. 4-6

Setchell & Gardner 1937, p. 89, pl. 8, fig. 22a-c; Dawson 1945, p. 62; Dawson 1950, p. 134, pl. fig. 27-28; Dawson 1957a, p. 8; Dawson 1959, p. 30; Dawson, Neushul & Wildman 1960a, p. 24.

Thalli epiphytic, attached to the host by short, branched, penetrating

rhizoids, 3-6 mm. high, the segments 100-300  $\mu$  in diam., dichotomously branched, corticated only at the nodes; corticating bands composed of approximately 5 horizontal rows of cells, although these are quite angular and irregularly placed, truncate on the lower side and the cells somewhat elongated and irregular on the upper side of the band, the band not swollen and the branches, thus, smooth on the margins; cells of axial filament subspherical, slightly longer than broad; tetrasporangia protruding on both adaxial and abaxial sides of the branches, sometimes in whorls of 3-4 at a node, not bracteate; spermatangia in low, pulvinate, adaxial patches at the nodes on upper segments; cystocarps lateral on upper branches, surrounded by involucre branchlets.

TYPE: J. T. Howell 757, August 14, 1932, in Herb. California Academy of Sciences (236529).

TYPE LOCALITY: Growing on *Codium fragile*, Bahía San Bartolomé (Tortuga), Baja California, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Hubbs 8/2/46, Isla Cedros; D. 20164 (Neushul), Punta Abreojos, 13 m.; D. 16154 (Limbaugh), Rocas Alijos. *Gulf of Calif.*—D. 18837, Bahía Agua Verde.

***Centroceras clavulatum* (C. Ag.) Mont.**

Pl. 26, fig. 7; Pl. 27, fig. 3

Montagne, in Durieu 1846, p. 140; Howe 1922, p. 509; Setchell & Gardner 1924, p. 779; Dawson 1944, p. 321; Dawson 1945, p. 62, 67; Dawson 1949, p. 224, 235; Dawson 1951, p. 53; Taylor 1945, p. 272. *Ceramium clavulatum* C. A. Agardh, in Kunth 1822, p. 2.

Thalli 2-3 cm. high or more, densely tufted, epiphytic or saxicolous, dull reddish, dichotomously branched with the two arms of each dichotomy equal in length and diverging 10-15°; axes 150-200  $\mu$  in diam., segmented, the internodes 300-600  $\mu$  long, corticated by small cells in regular longitudinal rows; nodes with a whorl of 1-2-celled spines; apices forcipate or circinate; tetrasporangia about 50  $\mu$  in diam., whorled at the nodes, emergent; sexual plants not seen.

TYPES A Humbolt & Bonpland specimen, in the Agardh Herbarium at Lund, Sweden (according to Howe).

TYPE LOCALITY: Callao, Peru.

MEXICAN DISTRIBUTION: This species is present throughout the entire Mexican coast from northwestern Baja California and the upper Gulf of California to Oaxaca. The following are a few representative collections: *Pacific Baja Calif.*—D. 8183, Isla Guadalupe; D. 8786, Bahía San Quintín; D. 8703, Punta Baja; D. 10398, Punta San Eugenio; D. 6623, Bahía Magdalena. *Gulf of Calif.*—Johnson 144, Isla Tortuga; D. 7069, Isla Carmén; D. 11040, near Guaymas; Marchant 87, Eureka. *Islas Tres Marias*—Taylor 39-634, Isla María Magdalena. *Sinaloa*—D. 10956, Bahía Topolobampo; D. 10925, Mazatlán. *Nayarit*—



D. 10855, San Blas. *Guerrero*—Taylor 34-570, Bahía Petatlán. *Oaxaca*—Taylor 34-549, Bahía Tangola Tangola.

***Centroceras bellum* Setchell & Gardner**

Pl. 27, fig. 4

Setchell & Gardner 1924, p. 779, pl. 26, fig. 48, pl. 40c, pl. 78.

Thalli 1.0-1.5 cm. high, more or less prostrate at the base and attached by numerous pluricellular hairs (1-3 at a node), becoming erect at the outer ends, completely corticated, subsecundly branched; main axes 110-130  $\mu$  in diam.; branches all arising at the nodes back of the growing point; tetrasporic ramuli stichidia-like, considerably enlarged for some distance above the base, each tapering very gradually to a blunt terminal growing cell, and more or less curved at the apex; corticating cells in regular longitudinal rows on the older parts of the thallus, quadrate except at the slightly swollen nodes and on the fruiting part of tetrasporic ramuli where they are divided into 2-4 smaller cells; tetrasporangia completely immersed, in a single whorl at each node; sexual plants unknown.

TYPE: Marchant 85, June, in Herb. University of California, Berkeley.

TYPE LOCALITY: Cast ashore at Guaymas, Sonora, Mexico.

This species has not subsequently been found in any of the Mexican collections although a specimen dredged by a Hancock Expedition from 15 fms. at Post Office Bay, Charles Island, Galapagos Archipelago, seems to agree with it, at least in sterile characters.

***Spyridia filamentosa* (Wulf.) Harv.**

Pl. 30, fig. 1-3

Harvey 1833, p. 336; Setchell & Gardner 1930, p. 167; Dawson 1949, p. 230. *Fucus filamentosus* Wulfen 1803, p. 64.

Thalli bushy or tufted, 2-20 cm. high, epiphytic or on rocks, shells or debris, very irregularly ramified, usually with multiple axes, the branches usually multifarious; principal axes 200  $\mu$  in diam., or more, gradually reduced at the tips, consisting of a row of very large axial cells covered with a complete cortex composed of alternating tiers of much smaller long and short cells in 1 or 2 layers; multifarious lateral branchlets about 40-60  $\mu$  in diam. at the base, reduced to 20  $\mu$  above, simple, of cells 1.0-1.5 diameters long, provided with a single terminal 2-3 celled spine, each cell node with a short cortical band; tetrasporangia tetrahedrally divided,  $\pm$  spherical, about 50  $\mu$  in diam., sessile from the cortical bands of the lateral branchlets; sexual plants not seen.

TYPE: The location of the Wulfen type is unknown.

TYPE LOCALITY: Adriatic Sea.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8783, 21671, 21630, 21752, Bahía San Quintín (intertidal); D. 2612 (Williams &



Kenyon), D. 2620 (Williams & Kenyon), Laguna de Scammon, 6 m.; Mason 80 (floating), D. 4045, 8180, 8330, 8613, 8487, Isla Guadalupe (intertidal); D. 9-40, Bahía Santa María, 35-45 m. (This material tends to be somewhat distichous). *Gulf of Calif.*—D. 3163, Punta Frailes (drift); *Revillagigedo Arch.*—Howell 360, Bahía Sulphur, Isla Clarión.

This tropical species is exceedingly variable in form and habitant, occurring in many kinds of environments from surfy shores to quiet bays and dim sublittoral bottoms. It is an abundant summer annual in the warm bays of Baja California and may be expected along all the warm coasts of Pacific Mexico. It appears in numerous collections from Central America.

### Key to the Mexican Species of *Griffithsia*

- |    |  |                       |
|----|--|-----------------------|
| 1. | Branching more or less regularly dichotomous .....   | 2                     |
| 1. | Branching irregular, more or less secund .....   | <i>G. tenuis</i>      |
| 2. | Cells oval or globular near tips .....   | <i>G. ovalis</i>      |
| 2. | Cells cylindrical, elongated in upper parts, not globular ....                                     | 3                     |
| 3. | Ultimate cells 70-125 $\mu$ in diameter .....  | 4                     |
| 3. | Ultimate cells 15-30 $\mu$ in diameter .....   | <i>G. multiramosa</i> |
| 4. | Spermatangia capitate on 1-celled branchlets .....   |                       |
|    | ..... <i>G. anthericephala</i>   |                       |
| 4. | Spermatangia on richly branched small branchlets between the articulations of upper branches ..... | <i>G. pacifica</i>    |

### *Griffithsia anthericephala* Daws.

Pl. 28

Dawson 1950a, p. 155, fig. 20-21.

Thalli 10-20 mm. high, epiphytic, consisting of dichotomously branched uniseriate filaments attached by specialized septate rhizodial branches; cells 150-280  $\mu$  in diam. in mid-parts, 4-6 diameters long, decreasing in diameter from upper to lower end and appearing, thus, constricted above the septa; apical cells blunt, reduced in mature plants to 100-70  $\mu$  in diam., without rings of hairs; spermatangia forming dense, ovoid, symmetrical, capitate clusters 80-125  $\mu$  in diam., terminating 1-celled branchlets from the cells of the upper parts of the plant, each such vegetative cell bearing 2-3 other cells in addition to the usually solitary spermatangial branch so that the ultimate branching becomes fairly dense, and, in being incurved, somewhat forcipate or dactyloid; tetrasporangia borne in much the same manner as the spermatangia, on 1-celled pedicels, 2 to several from a cell bearing 2-3 vegetative branches, about 70  $\mu$  in diam. at maturity, without an involucre; cystocarps scattered, borne on 1-celled lateral branchlets, with a prominent involucre of many incurved, 1-celled branchlets.

TYPE: Hubbs 12/7/46, epiphytic on *Laurencia*, in Herb. A. Hancock Foundation (36924).

TYPE LOCALITY: Intertidal, north side of reef on southwest tip of Isla Guadalupe, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8179, 8193, 8372, 8515, 8595 (intertidal); D. 8235, 8240 (6-20 m.), Isla Guadalupe; D. 10445, Campito, 12 mi. west of Punta San Eugenio, intertidal.

***Griffithsia multiramosa* Setch. & Gard.**

Pl. 32

Setchell & Gardner 1937, p. 87, pl. 4, fig. 10a-10c; Dawson 1944, p. 315; Dawson 1949, p. 230; Dawson 1951, p. 54. *Griffithsia multiramosa* var. *minor* Taylor 1939, p. 14. *Griffithsia multiramosa* var. *balboensis* Hollenberg 1945, p. 447, fig. 1.

Plants forming gregarious tufts about 2-4 (6-14) cm. tall, extremely soft, almost lubricous in texture, bright rose pink when dried; filaments branching pseudodichotomously, or occasionally slightly irregularly in upper portions; lower parts of the plant of coarse filaments which measure to 300  $\mu$  in diameter at the slightly swollen nodes, the thick-walled cells to 1350  $\mu$  long, the branching at wide angles; middle and upper portions of the plant of erect, more slender filaments branching at very acute angles, the cells to 970  $\mu$  long, somewhat clavate when supporting a fork, otherwise subcylindrical, about 125  $\mu$  in diam.; ultimate branching dichotomous, but more often alternate than elsewhere in the plant, the branchlets 15-30  $\mu$  in diam., their cells 100-200  $\mu$  long, those at the apices of the filaments tapered, rounded-acute; colorless hairs absent; tetrasporangia spherical, 50-75  $\mu$  in diameter, on 1-celled stalks, solitary at the nodes of the upper middle parts of the plant, apparently very infrequent, without any trace of involucre cells; sexual organs not seen (modified after Taylor).

TYPE: J. T. Howell 720, Aug. 4, 1932, in Herb. California Academy of Sciences (236490)

TYPE LOCALITY: Dredged from a depth of 20 fms., San Jose del Cabo, Baja California, Mexico.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8787, 8788, 8790, 21746, 21743, Bahía San Quintín; D. 19305 (Hubbs), D. 8442, Isla Guadalupe; D. 1581, near Punta María; D. 6527, Isla Cedros; D. 2570, 2629 (Williams & Kenyon), Laguna de Scammon; D. 6610, Bahía Magdalena; D. 6844, 6872, Bahía de San Lucas, 20-40 m. *Gulf of Calif.*—D. 231-40, 245-40, 270-40, Puerto Refugio, Isla Angel de la Guarda (all sublittoral); D. 594, Ensenada de San Francisco, intertidal; D. 624-40, Schmitt 13, July 19, 1938, vicinity of Punta Gorda, 12-50 m.

These several collections show a range in filament diameter including both the Setchell and Gardner type and the more slender material described by Taylor as var. *minor*, so that the use of varietal distinction here seems unwarranted. The same may be said for Hollenberg's var. *balboensis*.

The original description of the tetrasporangia as "cruciate" would seem, in the light of Taylor's studies, to have been a simple error in preparing the description. The illustrations are not clear on this point.

This is a species of the quiet waters of sheltered bays and lagoons, and also of deep, quiet, well-illuminated waters, the Hollenberg material having come from the former habitat, and the Taylor and Setchell and Gardner collections from the latter.

***Griffithsia ovalis* Harv.**

Pl. 29, fig. 1

Harvey 1862, pl. 203; Abbott 1946, p. 440, pl. 1, fig. 1-4, pl. 2, fig. 1-2.

Thallus tufted, to 2 cm. high, or creeping on other algae and decumbent but with erect filaments; cells oval to globular near the tips, 50-100  $\mu$  in diam., more or less moniliform in upper and midparts, larger, ellipsoidal to subcylindrical and 500-700  $\mu$  in diam. in middle and lower parts; branching essentially dichotomous, the tips sometimes slightly convergent; tetrasporangia borne in a whorled cluster between the subspherical cells near the tips, 40-50  $\mu$  in diam. at maturity, several on a pedicel, an involucre of 12-16 short, slightly incurved cells surrounding the whorl of sporangia; sexual plants not seen (modified from Abbott).

TYPE: A Harvey collection, epiphytic on *Zostera*, in the Harvey Herbarium, Trinity College, Dublin, Ireland.

TYPE LOCALITY: King George's Sound, Western Australia

MEXICAN DISTRIBUTION: *Revillagigedo Archip.*—D. 13564, 13567, Binnars Cove, Isla Socorro, intertidal.

***Griffithsia pacifica* Kylin**

Pl. 29, fig. 2; Pl. 31, fig. 1-4

Kylin 1925, p. 58, fig. 38-39; Dawson 1944, p. 314; Dawson 1949, p. 237; Dawson 1951, p. 53; Taylor 1945, p. 268 (doubtful); Dawson, Neushul & Wildman 1960, p. 64.

Thalli tufted, 3-5 cm. high, regularly dichotomously branched, the articulations cylindrical below, a little inflated at the upper ends above, 300-500  $\mu$  in diam. in middle and lower parts, reduced to 125-150  $\mu$  near the tips, the lower cells 5-7 times as long as broad or more; tips without branched filaments; tetrasporangia borne in a dense whorl between the articulations of upper branches, on small branchlets with unicellular involucre rays; spermatangia on richly branched small branchlets between articulations of upper branches, without involucre rays.

TYPE: A collection by H. Kylin in the Agardh Herbarium Lund, Sweden.

TYPE LOCALITY: Dredged from a depth of 5-10 fms., Turn Island, San Juan Islands, Washington.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 10346, 20604 (Neushul), Punta San Eugenio; D. 20589 (Neushul), Bahía Tortuga;



D. 20242 (Neushal), Punta Hughes, 25 m.; D. 13401, Isla Magdalena; D. 13293, Isla Margarita, 8 m. *Gulf of Calif.*—D. 163-40, Isla Tiburón; D. 382-40, Bahía Tepoca, 22 m.; D. 43-40, 73-40, 21710, vicinity of Guaymas.

Taylor's Revillagigedo Archipelago specimen is sterile and of uncertain identity.

A plant occurs abundantly in Bahía San Quintín, Baja California, that reaches a height of 8 cm. and produces late in the season (November-February) a large number of entangling rhizoids from the lower cells (Fig. 2, Plate 29). Fertile material has not been found, and the collections are referred here pending further study (D. 8719, 8729, 8775, 21621, 21638, 21681, 21668, 21747). Similar rhizoid-producing plants are at hand from Bahía Topolobampo, Sinaloa (D. 10962) and Salina Cruz, Oaxaca (D. 10754).

### *Griffithsia tenuis* C. Ag.

Pl. 31, fig. 5-7

C. Agardh 1828, p. 131; Tseng 1942, p. 106, fig. 1; Abbott 1946, p. 441, pl. 3, fig. 1-7; Dawson 1944, p. 315; Dawson 1949, p. 237; Dawson 1951, p. 54; Dawson 1959, p. 32.

Thalli forming loose tufts to 5 cm. high, attached to the substratum by unicellular rhizoids from decumbent filaments; branching sparse, irregular, subsecund, originating from the proximal ends of mother cells near the basal walls; cells essentially cylindrical, 100-180  $\mu$  in diam., 4-6 times as long; apices commonly provided with whorls of deciduous (dichotomous) hairs; tetrasporangia spherical, about 80  $\mu$  in diam. at maturity, without involucre cells, whorled, 4-12 at each of 2-3 fertile, subterminal nodes (about 3-4 cells below the tip), borne on a unicellular pedicel 30-40  $\mu$  in diam. and 1.5-2 diameters long; sexual plants not seen (modified from Tseng).

TYPE: A collection by Ruchinger, probably in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: At Venice, in the Adriatic Sea.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8155, 8158, 8619, 19301 (Hubbs), Isla Guadalupe; D. 2516 (Williams), Laguna de Scammon; D. 6625, Bahía Magdalena. *Gulf of Calif.*—D. 169-40, Puerto Refugio; D. 400-40, Isla Pond; D. 345-40, Punta Peñasco; D. 145-40, Isla Tiburón; D. 1768a, 21689, 21704, vic. of Guaymas; D. 7801, Bahía Concepción; D. 18644, Isla Tortuga; D. 18556, Isla San Pedro Nolasco; D. 18667, Isla Carmén; D. 7153, Puerto Escondido; D. 10849, Mazatlán; D. 10955, 10899, Bahía Topolobampo; D. 6958, Isla Espíritu Santo. *Guerrero*—D. 21346, Isla Grande.

### *Microcladia coulteri* Harv.

Pl. 30, fig. 4-5

Harvey 1853, p. 209, pl. 33, fig. A; Dawson 1945, p. 67; Dawson 1949,



p. 227; Dawson, Neushul & Wildman 1960, p. 68, pl. 37, fig. 3-4.

Thalli epiphytic, with an irregularly branched holdfast completely embedded in the host, 5-12 cm. high, deep rose-red, with a percurrent axis branching into several orders; branching regularly alternate, distichous and all the branches lying in one plane; lower part of an axis usually with longer branches and the whole shoot appearing pyramidal; branches of the first second and third orders usually straight, those of the ultimate orders curved and forcipate; cystocarps restricted to branches of the final orders, with an involucre of 3-6 curved, corticated branchlets; tetrasporangia densely crowded beneath the surface of all sides of the branches of the last three orders; spermatangia not seen (modified from Smith) .

TYPE: A collection by Thomas Coulter in the Harvey Herbarium, Trinity College, Dublin.

TYPE LOCALITY: Monterey, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 102-45, D. 235 (Fork & Hommersand), Punta Descanso; D. 4 (Hubbs), Punta Clara; D. 20, 55, 5167, 5170, Cabo Colnett; D. 135a (Fork), Rio San Telmo; D. 20870 (Neushul), near Punta Cabras; D. 8769, 9651, outer peninsula of San Quintín; D. 1131, 1132, 1257, 1295, 8675, 8839, 8855a, Punta Baja; D. 1487, Punta Santa Rosalía.

### *Neoptilota densa* (C. Ag.) Kylin

Pl. 33, fig. 1-2

Kylin 1956, p. 393. *Ptilota densa* C. Agardh 1822, p. 387; Dawson 1949, p. 223.

Thalli 10-25 cm. tall, dull brownish red, with an obscure main axis, several of the lower branches often equalling it in length; sides of axis and major branches densely fringed with leaflets and very short branchlets bearing leaflets; leaflets and short branchlets in opposite pairs and regularly alternate; leaflets falcate, with the adaxial margin smooth and concave, the abaxial margin strongly serrate and convex; cystocarps borne at tips of short, fringing branchlets, globose, about 150  $\mu$  in diam., surrounded by an involucre of incurved rays; tetrasporangia elliptical, 30-45  $\mu$  in diam., borne in dense clusters on short branchlets opposite falcate leaflets and appearing to be in their axils, also in part on short branchlets from basal margins of leaflets.

TYPE: A specimen marked "e coll. Haenkiana" in Herb. Agardh, Lund, Sweden.

TYPE LOCALITY: Monterey Peninsula, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Cooper 776, Punta Santo Tomás; D. 6439, Bahía Colnett (This is an unusually finely dissected example. The falcate "leaflets" are not abaxially serrate, but actually branched so that the "leaflet" aspect is nearly lost above, and

completely so below. D. 9670, 9701, outer peninsula at Bahía San Quintín; D. 1147, 8907, Punta Baja; D. 8701, Bahía Rosario.

***Ptilota filicina* (Farl.) J. Ag.**  
Pl. 33, fig. 3-4

J. Agardh 1876, p. 76; Dawson 1949, p. 220. *Ptilota plumosa* var. *filicina* Farlow 1875, p. 374.

Thalli usually 10-35 cm. tall, bright red, with several long branches and these with 2-4 orders of branching; branches with leaflets and unbranched branches in opposite pairs and regularly alternate; leaflets slightly falcate, with both margins serrate, the tips acute; branches opposite the leaflets frequently 2-5 cm. long and with well-developed leaflets; tetrasporangia elliptical, about 65  $\mu$  long, scattered among branchlets in special branches from adaxial margin of leaflets, these tufted, multifarious, of incurved, mostly uniseriate short filaments; cystocarps borne on ultimate branchlets, modifying them to appear as shortly-pedicellate, tufted bodies about 500  $\mu$  in diam. consisting of a spherical gonimoblast surrounded by a clasping involucre of short filaments.

TYPE: A collection by Capt. Pike, labeled "*Ptilota californica* var. *concinna*" in Herb. Harvey, Trinity College, Dublin.

TYPE LOCALITY: Golden Gate [San Francisco], California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 5156, Cabo Colnett; D. 124, Rio San Telmo; D. 8734, 9683, outer peninsula of Bahía San Quintín; D. 8906 Punta Baja.

DELESSERIACEAE  
Key to the Genera in the Mexican Flora

- |  |                      |
|--|----------------------|
| 1. Apex with horizontally divided primary apical cell .....                                  | 2                    |
| 1. Apex without a horizontally divided primary apical cell .....                             | 16                   |
| 2. Intercalary divisions absent in cell rows of the first order .....                        | 3                    |
| 2. Intercalary divisions present in cell rows of the first order .....                       | 9                    |
| 3. All tertiary apical cells reaching the thallus margin .....                               | 4                    |
| 3. Not all tertiary apical cells reaching the thallus margin .....                           | 5                    |
| 4. Thallus branching from the margins ..... <i>Branchioglossum</i>                           |                      |
| 4. Thallus branching from the midrib ..... <i>Hypoglossum</i>                                |                      |
| 5. Intercalary cell divisions lacking .....  | 6                    |
| 5. Intercalary cell divisions in the cell rows of the second and higher orders present ..... | <i>Grinnellia</i>    |
| 6. Blades ligulate, narrow, less than 300 $\mu$ wide .....                                   | 8                    |
| 6. Blades not ligulate, broader, 2 mm. to 3-4 cm. wide .....                                 | 7                    |
| 7. Thallus with polystromatic midrib and monostromatic marginal parts .....                  | <i>Membranoptera</i> |
| 7. Thallus polystromatic throughout; reproduction in special small leaflets .....            | <i>Holmesia</i>      |



- |     |  |                       |
|-----|--|-----------------------|
| 8.  | Blade tips with 1-3 monosiphonous, multicellular hairs ....  |                       |
|     | .....  | <i>Taenioma</i>       |
| 8.  | Blade tips without hairs .....   | <i>Platysiphonia</i>  |
| 9.  | At least younger thallus parts of a single layer of cells .....  | 10                    |
| 9.  | Polystromatic throughout .....   | <i>Nienburgia</i>     |
| 10. | Midrib lacking or faint .....  | 11                    |
| 10. | Midrib present and very conspicuous .....  | 15                    |
| 11. | All nerves and veins absent .....  | <i>Haraldia</i>       |
| 11. | Nerves and (or) veins present .....  | 12                    |
| 12. | A faint midrib present, but side nerves and veins lacking  | 13                    |
| 12. | Nerves running irregularly, anastomosing .....   | 14                    |
| 13. | Sporangia in sori along the thallus margin ....  | <i>Erythroglossum</i> |
| 13. | Sporangia in sori aggregated near the thallus tip .....  | <i>Sorella</i>        |
| 14. | Branching from the thallus margin .....  | <i>Polyneura</i>      |
| 14. | Branching from the lower, stripe parts ....  | <i>Polyneurella</i>   |
| 15. | Blades 5 mm. wide or more; sporangial sori scattered .....   |                       |
|     | .....  | <i>Phycodrys</i>      |
| 15. | Blades 4 mm. wide or less; sporangial sori along the thallus margins .....   | <i>Anisocladella</i>  |
| 16. | Microscopic veins lacking .....  | 17                    |
| 16. | Microscopic veins present .....  | 19                    |
| 17. | Thalli minute, parasitic, the free parts terete .....  | <i>Polycoryne</i>     |
| 17. | Thalli not parasitic, with free blades .....   | 18                    |
| 18. | Thalli with dichotomously branched main nerves .....   |                       |
|     | .....  | <i>Schizoseris</i>    |
| 18. | Thalli without nerves or veins .....   | <i>Myriogramme</i>    |
| 19. | Thalli with frequent hamate branches .....   | <i>Acrosorium</i>     |
| 19. | Thalli without hamate branches .....   | 20                    |
| 20. | Tetrasporangia developing both from the cortex and the axial filament; thalli 1-20 cm. tall, to 15 mm. broad ..... |                       |
|     | .....  | <i>Cryptopleura</i>   |
| 20. | Tetrasporangia developing wholly from the cortex; thalli 10-30 cm. tall, 1-3 cm. broad .....                       | <i>Botryoglossum</i>  |

### ***Branchioglossum undulatum* Dawson**

Pl. 33, fig. 5-6

Dawson 1949, p. 18, Fig. 39-42; Dawson Neushul & Wildman 1960a, p. 24.

Thalli to 2 cm. high from a small, spreading, semi-clasping discoid holdfast, consisting of several delicate, membranous blades arising from the base, these sublanceolate in outline, 2-5 mm. broad, 1 or 2 times pinnately branched (lobed) from the crisped or undulate margins; midrib prominent; lateral veins present but inconspicuous; apices obtuse; cystocarps abundant, on both surfaces of the blades along the midrib and along main veins of lateral pinnae, projecting, hemispherical,



450-600  $\mu$  in diam., with a prominent, flared rostrum; spermatangial blades with more conspicuous undulation of margins than cystocarpic; spermatangia marginal over whole of mature blades in closely spaced elongated, partially confluent, stripe-like sori, marginal and diagonal with respect to the midrib in the same manner as the primary cell rows at the blade apex; tetrasporangia in irregular patched sori midway between midrib and margin of blade; tetrasporic blades narrower and somewhat more attenuate than cystocarpic or spermatangial ones.

TYPE: A collection by C. L. Hubbs, 47-96d, in Herb. A. Hancock Foundation (26861).

TYPE LOCALITY: On *Macrocystis* holdfasts in San Miguel Passage off Santa Rosa Island, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 20401 (Neushul) Punta Asunción.

***Branchioglossum woodii* (J. Ag.) Kylin**

Pl. 34, fig. 1; Pl. 39, fig. 1.

Kylin 1924, p. 8, fig. 2 A; Dawson 1944, p. 321; Dawson 1949, p. 234, 237, as *Sorella pinnata*; Dawson 1954, p. 344; Dawson 1957a, p. 8; Dawson 1959, p. 29; *Branchioglossum macdougalii* Gardner 1927b, p. 103, pl. 20, fig. 4, pl. 33, 34. *Delesseria woodii* J. G. Agardh 1872, p. 54.

Thalli 2.0-7.5 cm. tall, usually epiphytic, bushy, of deep pink color, with a percurrent axis profusely and suboppositely branched, the branches similar to the main axis and with one or two orders of branching; axis and branches linear, 1-2.5 mm. broad, abruptly attenuated at upper end and terminating in an acute tip; midrib of axis and major branches at first delicate, later flattened and up to 500  $\mu$  broad or more; monostromatic portion of branches with cells near branch tips arranged with graphic regularity; tetrasporangia in interrupted linear sori on either side of midrib of branches.

TYPE: A Dr. C. B. Wood collection from Herb. Asa Gray, probably to be found in the Agardh herbarium, Lund, Sweden.

TYPE LOCALITY: Vancouver Island, B. C.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8437, Isla Guadalupe, 45-55 m.; D. 10085, 11 mi. west of Punta Malarrimo, Bahía Viscaíno; D. 16166 (Limbaugh), Rocas Alijos. *Gulf of Calif.*—D. 378-40, Bahía Tepoca (22 m); D. 751, Isla Patos; MacDougal Nov. 1923, Puerto Libertad; D. 894, Isla Tiburón; D. 475e-40, 3527, 1904, D. 10996, D. 21706, Ensenada de San Francisco near Guaymas; D. 18723, Isla Ildefonso.

***Hypoglossum attenuatum* var. *abyssicolum* (Taylor) comb. nov.**

Pl. 34, fig. 3

*Hypoglossum abyssicolum* Taylor 1945, p. 277, pl. 89, fig. 1-2; Dawson 1944, p. 321 (in part, as *H. attenuatum*); Dawson 1949, p. 231 (as *H. attenuatum*); Dawson 1951, p. 56 (as *H. attenuatum*).



Thalli up to 12 cm. tall, the lower parts usually denuded, slender and firm, sparingly branched from the midrib, above broadly and delicately alate, the wings one cell thick and without lateral veinlets, the midrib becoming faint in ultimate divisions; blades in sterile and tetrasporangial plants narrowly lanceolate, tapering about equally to the base and the apex, reaching 2.5-7.5 cm. in length and 5 mm. in width; cystocarpic plants more bushy with blades to 6 mm. wide and the ultimate ones commonly short, broad and with broadly obtuse ends; cystocarps usually solitary on the midrib of ultimate and subultimate blades, 0.9-1.2 mm. in diam.; tetrasporangia borne in oblong sori to 3 mm. long on either side of midrib; spermatangia not seen.

TYPE: Taylor 34-381, Jan. 29, 1934, in Herb. A. Hancock Foundation.

TYPE LOCALITY: Dredged from 56 meters, Post Office Bay, Isla Santa María, Galapagos Archipelago.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 4044 (Hubbs), D. 4094 (Hubbs), D. 8364, 8470, 8447, Isla Guadalupe, intertidal to 65 m.; D. 9016 (Hubbs, Johnson & Allanson), Laguna de San Ignacio. *Gulf of Calif.*—D. 267-40, Puerto Refugio, Isla Angel de la Guarda, 12-22 m.; D. 21553 (Calif. Fish & Game), Isla San Esteban, 10-40 m.; D. 923, Isla Tiburón; D. 7183, Puerto Escondido; D. 6984, Bahía Salinas, Isla Carmén; D. 6735, Punta Frailes; D. 6921, Canal de San Lorenzo, Isla Espíritu Santo; D. 6881, 6870, 6836, Howell 48a, Bahía de San Lucas, 20-40 m. *Sinaloa*—Remple 4/1/37, off Punta Piaxtla, 12-16 m; Remple 4/2/37, off Isla Isabel, 20-35 m. *Isla Trés Marias*—Taylor 39-649, Hancock Sta. 970, 9/V/39. *Oaxaca*—D. 21320 Puerto Guatulco, 11 m.; D. 21263, Bahía Chamela, 20 m.

***Hypoglossum attenuatum* Gardner var. *attenuatum***

Gardner 1927b, p. 104, pl. 20, fig. 3, pl. 35-36.

Much like the variety *abyssicolum* described above, but more abundantly branched and smaller throughout, the blades only 1-2 (2.5) mm. wide and more acuminate.

TYPE: A collection by T. C. MacDougal, November 1923, in Herb. University of California, Berkeley (296658)

TYPE LOCALITY: Epiphytic on *Sargassum*, Puerto Libertad, Sonora.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 8028, Puerto Refugio, Isla Ángel de la Guarda, 20 m; D. 665, Puerto Libertad, cast ashore; D. 303-40, Bahía Gonzaga, 60-80 m.; D. 60-40 Bahía Guaymas, 4-6 m.

These materials from the upper Gulf of California, including the type locality, are the only ones from the Gulf region as small and narrow as the type. Most specimens are larger, broader, and more in accord with Taylor's *H. abyssicolum*, but there are a number of inter-

mediates that satisfactorily indicate that these are variants of a single natural species.

*Pacific Baja Calif.*—D. 21651, 21738, 8727, Bahía San Quintín, epiphytic in shallow water. These are luxuriant, bushy plants even more densely branched than the type and with somewhat shorter branches. The quiet, isolated bay habitat would seem in this instance to reproduce the ecological conditions under which this species thrives in the Gulf of California.

### ***Hypoglossum retusum* Dawson**

Pl. 35, fig. 1-2

Dawson 1944, p. 107, fig. 17-18; Dawson, Neushul & Wildman 1960a, p. 25.

Thalli to 27 mm. high (or more) with a cylindrical main stipe from which several blades arise irregularly as lateral branches; blades oblanceolate, 11-16 mm. long, 3.5-4.5 mm. wide, attached to the main stipe by a slender petiole 2-4 mm. long, monostromatic except at the percurrent midrib, without lateral veins, frequently with a series of rhizoids growing from the margin, with an apical notch from which the apical growing point is turned backward and downward, the meristem itself acute and growing by means of an apical cell; intercalary divisions of primary cell row absent; initials of tertiary cell rows reaching the thallus margin; reproduction not seen.

TYPE: A collection of May 1944, without designated collector [actually Kenneth O. Emery] in Herb. University of California, Berkeley.

TYPE LOCALITY: Rocky bottom of Kellet Channel, off south shore of Isla Cedros, Baja California, Mexico, at a depth of 40-50 m.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 20527 (Neushul), northeast of Punta Eugenio, 35 m.

### ***Membranoptera spatulata* Dawson**

Pl. 35, fig. 5

Dawson 1950a, p. 157, fig. 15.

Thalli to 1 cm. high, consisting of a dense group of small, membranous, spatulate blades arising on short pedicels from a creeping, basal portion spreading over and around branches of hydroids; blades monostromatic except at the midrib, 2.0-2.5 mm. wide, undulate, with entire margins, with abundant, pinnate, parallel, primary microscopic veins and connecting secondary veins; growth by means of an apical cell; intercalary division absent from primary cell row; apices rounded, the apical cell forming a small apiculum; blades unbranched, or at times in age more or less lacerated and lobed or branched from margins near the apex; spermatangia borne in elongated sori occupying the interstices between the microscopic veins over whole of the monostromatic blade; midrib becoming heavily corticated by growth and septation of very slender rhizoidal cells from the elongated cells of the primary

cell row and the similar, parallel, basal cells of the secondary cell rows; cysocarpic and tetrasporic plants not seen.

TYPE: Dawson 755a, Feb. 18, 1946, in Herb. A. Hancock Foundation (43230).

TYPE LOCALITY: On intertidal rocks in crannies, northeast side of Isla Patos, Gulf of California, Mexico.

This species is distinguished from others of the genus by its tufted habit and typically unbranched, blunt-spatulate blades which, compared to other species of *Membranoptera*, are relatively broad with respect to length.

***Holmesia californica* (Dawson) Dawson**

Pl. 35, fig. 6-7; Pl. 36

Dawson 1945b, p. 96. *Loranthophycus californicus* Dawson 1944, p. 655, fig. 1-4.

Thalli erect, membranous, to 12 cm. high, rose colored, attached to rocks by a thin, adherent crust augmented by a few short clasping stolons, expanded from a branched, subterete stipe 1.0-1.5 cm. high; blades 3-4 from each main stipe, narrowly cuneate for 1.5-2.0 cm. above the point of branching, then expanding abruptly into a thin, smooth, veinless, narrow-ovate, membranous portion 3-4 cm. broad, this usually simple, but sometimes divided above the middle; margins irregularly shallowly lobed or undulate; transection showing an external layer of small, flattened, pigmented, rectangular cells and several irregular medullary layers of large, colorless, thin-walled cells; tetrasporangia borne in special fertile branchlets from the surface of the membranous blades; fertile branchlets 1-2 mm. long, simple or forked, compressed, acute, 400  $\mu$  broad, 200  $\mu$  thick, from a cylindrical base; tetrasporangia scattered, 90-100  $\mu$  in diam.; sexual plants not seen.

TYPE: A collection by Martin W. Johnson, Mar. 10, 1944, in Herb. University of California, Berkeley.

TYPE LOCALITY: Dredged from a rocky bottom at a depth of 25 meters off Point Loma, San Diego, Calif.

MEXICAN DISTRIBUTION: This species has been reported now from much of the Pacific Coast from Washington State to southern California (a recent collection is Dawson 5808, at 41 m., off Santa Cruz Island), and, since the type came from very near the Mexican boundary, may be expected in moderate depths along the northwest coast of Baja California.

***Schizoseris pygmaea* Dawson**

Pl. 35, fig. 3-4

Dawson 1950a, p. 157, fig. 16-17; Dawson 1959, p. 29.

Thalli 1-2 (3) cm. high or more, from a discoid base, or the base a  $\pm$  prostrate, terete structure with rhizoidal attachments, consisting of one to several irregularly, dichotomously branched or lobed monostroma-



tic, stipitate blades 2.0-2.5 mm. broad with strongly developed midribs extending to within 200-600  $\mu$  of the tips; branching of new blades from lower stipe parts or occasionally from the midrib of a blade; young blades obovate, becoming vaguely palmate; sometimes eroding early to leave the persistent midrib, with entire margins above except for occasional production of rhizoidal outgrowths from the margins, more or less undulate and with rounded apices; midrib 200-300  $\mu$  thick, consisting in transection of a group of subspherical, colorless medullary cells 30-50  $\mu$  in diam. and a pigmented cortex of smaller cells more or less like those of the blade, without rhizoidal filaments; growth from a group of terminal initials; blade cells in surface view 6-12  $\mu$  in greatest diameter; tetrasporangia borne in sori usually occurring as a single, broadly rounded patch in the middle or upper part of a blade and occupying most of its width.

TYPE: E. Y. Dawson 1008, Feb. 22, 1946, in Herb. A. Hancock Foundation (5361).

TYPE LOCALITY: Intertidal rocks, Isla Partida, Gulf of Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 10448, 12 mi. east of Punta Eugenio, Bahía Vizcaino. *Gulf of Calif.*—D. 853, 861, Isla Jorge; D. 738, 755, Isla Patos; D. 18568, Isla San Pedro Nolasco, on thin sponges at 1-2 m.; D. 18873, El Solitario, Bahía Agua Verde; D. 18673, Isla Cholla, off Isla Carmén.

This species closely resembles *Myriogramme subdichotoma* Segawa, but seems to differ in its less extensive dichotomy and in its large, usually solitary tetrasporangial sori occupying the greater part of the breadth of a fertile segment.

### *Platysiphonia clevelandii* (Farlow) Papenfuss

Pl. 39, fig. 4; Pl. 40, fig. 1

Papenfuss 1944, p. 206; Silva & Cleary 1954, p. 258-259, fig. 27a. *Taenioma clevelandii* Farlow 1877, p. 236.

Thalli epiphytic or entangled, attached by rhizoids, to 2 cm. in extent, consisting of ligulate acuminate blades 90-175  $\mu$  broad branched dorsiventrally from the center line of each blade; blades 5 cells broad, composed of a central axial cell row surrounded by four pericentral cells, each lateral pericentral cell flanked by two cells; base of branches with lower two segments lacking flanking cells; tetrasporangia produced in ultimate blades by acropetal succession, in two longitudinal rows, one sporangium by each lateral pericentral cell and bordered by two flanking cells which divide vertically to produce two more; sexual plants not seen.

TYPE: A collection by Daniel Cleveland in the Farlow Herbarium, Harvard University.

TYPE LOCALITY: San Diego, California.



MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 2583, 2586 (Williams & Kenyon) Isla Cedros, 20 m.; D. 2565, 2621, 2605, 2596 (Williams & Kenyon), Laguna de Scammon, 4-6 m.

*Platysiphonia clevelandii* differs from *P. parva* in that two pairs of flanking cells, instead of one, border each sporangium in a tetrasporangial branch; also that the two lowermost segments of a branch lack flanking cells, while in *P. parva* only the basalmost segment lacks flanking cells.

***Platysiphonia parva* Silva & Cleary**

Pl. 39, fig. 2-3

Silva & Cleary 1954, p. 259, figs. 1-37.

Thalli epiphytic, to 2 cm. tall, attached by rhizoids, consisting of ligulate, acute or acuminate blades 125-200  $\mu$  broad branched dorsiventrally from the center line of each blade; blades five cells broad, composed of a central axial cell row surrounded by four pericentral cells, each lateral pericentral cell flanked by two cells; base of branches with only the basal cell segment lacking flanking cells; tetrasporangia produced in ultimate blades in two longitudinal rows, by acropetal succession, one sporangium by each lateral pericentral cell bordered by two flanking cells only, which do not divide vertically; cystocarps urceolate, slightly asymmetrical, prominent, 225-445  $\mu$  in diam., 260-500  $\mu$  high; spermatangia forming an elongated sorus on either side of the mid-line of ultimate blades, arising from the pericentral cells.

TYPE: Silva 5786, Jan 27, 1950, in Herb. University of California, Berkeley.

TYPE LOCALITY: Melpomene Cove, Isla Guadalupe, Baja California

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 4086, 4139 (Hubbs), Dec. 7, 1946, Melpomene Cove, Isla Guadalupe, 20-35 m.; D. 8228, 8408, south anchorage, Isla Guadalupe, 6-20 m.; D. 8468 Melpomene Cove, Isla Guadalupe, 80 m.

This seems to be a Guadalupe Island endemic, for all of the specimens of this genus from that locality are *P. parva*, while all those from mainland Baja California localities are *P. clevelandii*.

***Taenioma perpusillum* (J. Agardh) J. Agardh**

Pl. 37, fig. 1, Pl. 47, fig. 3

J. Agardh 1863, p. 1257; Papenfuss 1944, p. 206, pl. 23, 24; Dawson 1944, p. 324. *Polysiphonia perpusilla* J. Agardh 1948, p. 16.

Thalli minute, epiphytic or saxicolous, 2-3 mm. high, consisting of horizontally creeping, branched, cylindrical, ecorticate, polysiphonous branches 130-150  $\mu$  in diam., attached to the substrate by unicellular rhizoids below and giving rise on the upper side to erect or ascending branches; erect parts giving rise to alternate determinate branchlets with short cylindrical base and flat, ligulate blades about 100  $\mu$  broad, 500-1000  $\mu$  long, terminating in 1-3 long terminal hairs (luxuriant,

growing material usually with three hairs); tetrasporangia disposed in two rows along the axis of determinate branchlets; sexual plants not seen.

TYPE: A collection by Liebmann in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: San Agustín, Mexico (presumably along the coast of Oaxaca in the Isthmus of Tehuantepec region).

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 325-40, Bahía Gonzaga; D. 392-40, Bahía Tepoca; D. 406b-40, Isla Pond; D. 540a-40, Bahía Agua Verde; D. 978, Isla Tiburón; D. 18948a, Isla Espiritu Santo; D. 10891, 10908, Bahía Topolobampo.

Several of these materials are in good growth and show a frequent to regular development of the three terminal hairs. However, D. 978 is apparently somewhat dwarfed or stunted and shows only single apical cells or hairs, or, occasionally, tips with two hairs, but not three. Standing alone this plant might well be placed in *Taenioma macrourum* Thuret according to the interpretation of Tseng 1944, but in D. 10891 one can find in almost every slide field of the material tips with one, two and three hairs, so that it is difficult to accept the number of terminal hairs as a basis for distinguishing these two species.

### *Sorella delicatula* (Gardner) Hollenberg

Pl. 34, fig. 2

Hollenberg 1943, p. 577. *Erythroglossum delicatula* Gardner 1926, p. 208, pl. 18. *Sorella delicatula* var. *californica* Hollenberg 1943, p. 577, fig. 13-14. *Erythroglossum divaricatum* Gardner 1926, p. 207, pl. 17, fig. 2. is probably included here but fertile material is needed for verification.

Thalli 1-2 cm. high (sometimes up to 10 cm. in quiet, deep water), mostly dichotomo-flabellately branched, the flattened divisions 200-500 (600)  $\mu$  broad; margins smooth; blades monostromatic except at the inconspicuous midrib; tetrasporangia sori oval, 200-400  $\mu$  broad, usually solitary in the center of branches near the ends; cystocarps 400-450  $\mu$  in diam., occupying nearly the entire width of branches; spermatangial sori occurring singly as irregular oval patches at the very tips of the branches.

TYPE: Mrs. H. D. Johnston 139, June 1899, in Herb. University of California Berkeley (94715).

TYPE LOCALITY: Washed shore, San Pedro, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 4226, on a *Halio-*  
*tus* shell from 4 m., east side of Isla Coronado del Norte.

Recent collections of this plant have shown that the type specimen probably represents a maximum development of stature in a deep-water plant, while most materials collected at lowest tide levels are dwarfish plants only 1-2 cm. high. Experience with this and other related genera indicate that these size differences are related directly to the local environment and usually reflect the amount of agitation under which the

plant grows. See also *S. pinnata* for similar responses demonstrated by collections from the Gulf of California.

***Sorella pinnata* Hollenberg**

Pl. 38, fig. 1; Pl. 40, fig. 6

Hollenberg 1943, p. 578, fig. 15-16; Dawson 1944, p. 321, pl. 47, fig. 3-4; Dawson 1951, p. 53.

Thalli 1-2 cm. tall (or up to 7 cm. in luxuriant examples), rose pink in color, semi-prostrate in inferior parts, the segments membranous, lanceolate, 0.5-2 mm. (sometimes to 3.5 mm.) broad, with acute, obovate to lanceolate, irregularly pinnate branchlets and dentae, with an inconspicuous midrib, monostromatic except at the midrib and in lower parts; growth from an apical cell, the primary cell row with intercalary division; margins minutely denticulate; tetrasporangial sori 300-400 (800)  $\mu$  in diam., oval, solitary in the middle of branches near the tips; cystocarps 400-500  $\mu$  in diam., on one side of the midrib, with a single pore; spermatangial sori oblong, 150-200  $\mu$  in diam., mostly in pairs, one on either side of the midrib and often several pairs occurring on a single branch.

TYPE: Hollenberg 3921, Nov. 7, 1942, in the herbarium of G. J. Hollenberg, University of Redlands, Calif.

TYPE LOCALITY: On intertidal rocks, Laguna Beach, Orange Co., Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8011, Cortez Bank, 30-40 m.; D. 4225, Isla Coronado del Norte; D. 10564, Isla Cedros; D. 9421, Islas San Benito; *Gulf of Calif.*—D. 856, Isla Jorge; D. 194-40, Puerto Refugio, Isla Ángel de la Guarda; D. 666, Puerto Libertad (growing luxuriantly (to 7 cm. tall) with *Branchioglossum woodii* in the subtidal, and of similar habit).

***Grinnellia lanceolata* Dawson**

Pl. 39, fig. 5

Dawson 1944, p. 322, pl. 47, fig. 6.

Thalli 2.5-6 cm. tall, consisting of several short-stipitate blades from a minute, pulvinate or discoid holdfast; blades lanceolate at first, 6-8 mm. wide, expanding to 2-3 cm. wide, monostromatic except at the delicate midrib, undivided, without side nerves, with entire, only slightly undulate margins, the apices blunt, with an apical cell; primary cell row without intercalary divisions; tetrasporic sori scattered over blades on either side of midrib, tending in part to be oriented in faintly decussate rows; spermatangial sori irregular, angular, 50-500  $\mu$  in extent, scattered over blades; cystocarps scattered over the thallus, up to 1 mm. in diam., seeming to have a small scale-like projection on one side, but this actually representing the tip of the fertile leaflet on the midrib of which the procarp develops (very young cystocarps project downward



from the abaxial surface of these very short leaflets).

TYPE: Dawson 626-40, Feb. 15, 1940, in Herb. A. Hancock Foundation (57).

TYPE LOCALITY: Dredged from a depth of 34-50 m., off Punta Gorda, Baja California del Sur.

MEXICAN DISTRIBUTION: *Baja Calif. del Sur*—D. 7192, Puerto Escondido, 6-10 m.; 6835, 6866, Bahía de San Lucas, 20-37 m.

***Polyneura latissima* (Harv.) Kylin**

Pl. 40, fig. 2

Kylin 1924, p. 37, fig. 27-28; Dawson 1945c, p. 102; Dawson 1949, p. 220; Dawson, Neushul & Wildman 1960, p. 72, pl. 38, fig. 4. *Hymenena latissima* Harvey 1862, p. 170.

Thalli 10-15 cm. tall or more, sessile or shortly stalked, flat, membranous, pinkish to reddish, the young blades oblanceolate, becoming somewhat palmately branched or lobed, the older ones more or less deeply incised or lacerated, the segments 2-6 cm. broad; veins conspicuous and relatively coarse, anastomosing to form an areolate reticulum covering all but the blade margins; tetrasporangial sori minute, scattered over both surfaces of the blade, several in each inter-reticular area between veins; cystocarps numerous, large projecting, irregularly disposed over both surfaces; spermatangia forming dull whitish patches over the entire surface which becomes ridged, indented or rugose.

TYPE: A collection by Dr. Lyall and C. Wood, in the Harvey Herbarium, Trinity College, Dublin.

TYPE LOCALITY: Esquimalt Harbor, British Columbia.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Cooper 864, 7 mi. north of Punta Descanso; D. 8038 (Hubbs), Bahía Descanso; D. 136, Rio San Telmo; D. 9648b, outer peninsula, Bahia San Quintin; D. 20867 (Neushul) near Punta Cabras; D. 20628, 20804 (Neushul), near Punta Eugenio; D. 9546, 9549 off Punta San Hipolito, 68 m. D. 9552, Isla Guadalupe, 68 m.

***Polyneurella hancockii* Dawson var. *hancockii***

Pl. 40, fig. 3-4

Dawson 1944, p. 323, pl. 47, fig. 1-2.

Thalli 6 to 6.5 cm. high, composed of numerous short-stipitate, entire, ovate-lanceolate, membranous, rose-colored blades 2-3.5 cm. wide, 5-6 cm. long when mature, arising from a semi-terete axis several times branched above a small discoid holdfast; blades entire, the margins smooth or with an occasional proliferous bladelet, monostromatic in younger parts, growing by means of an apical cell, without a midrib but with many microscopic veins (some becoming macroscopic in older blades); the veins tending to be parallel and to run longitudinally, tetrasporangial sori scattered over blades, more or less regularly spaced,



small, rounded, blister-like, to 1 mm. in diam., each bearing 100 or more tetrasporangia; sexual plants unknown.

TYPE: Dawson 184-40, Jan. 28, 1940, in Herb. A. Hancock Foundation (no. 58).

TYPE LOCALITY: Dredged from 22-44 m., Puerto Refugio, Isla Ángel de la Guarda, Gulf of California, Mexico.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 7070, off Punta Frailes, 40 m.

***Polyneurella hancockii* var. *rhizoidea* var. nov.**

Pl. 37, fig. 2

Varietas typo similis, basi, autem, prostrata succulenta adhaerente, marginibus laminae satis proliferis, hic illic proliferationibus aggregatis radiciformibus ramosis patentibus manifestis; praeditis; sori tetrasporangiales minimi, plerumque minores quam 300  $\mu$  diam.

Like the type but the base a prostrate, fleshy, adherent structure and the blade margins somewhat proliferous and provided here and there with prominent groups of branched, spreading, root-like outgrowths; tetrasporangial sori very small, mostly less than 300  $\mu$  in diam.

TYPE: Dawson 6869, Mar. 11, 1949, (consisting of liquid preserved material and slide) in Herb. A. Hancock Foundation.

TYPE LOCALITY: Dredged in 20 fms. Bahía de San Lucas, Baja California, Mexico.

ADDITIONAL MATERIAL: D. 6840a, Dredged 10 fms., Bahía de San Lucas, Baja Calif.

***Nienburgia andersoniana* (J. Agardh) Kylin**

Pl. 41; Pl. 42, fig. 1

Kylin 1935, p. 1; Taylor 1945, p. 280; Dawson 1945, p. 67; Dawson 1949, p. 223; Dawson 1951, p. 53; Dawson, Neushul & Wildman 1960, p. 68, pl. 38, fig. 1. *Neuroglossum andersonianum* J. Agardh 1876, p. 474.

Thalli to 26 cm. high, consisting of repeatedly pinnately branched ligulate, membranous blades from a stoloniferous holdfast, the prostrate branches with toothed margins; erect axes often stem-like at the base, of variable width above, mostly 3-5 mm., but sometimes only 1.5-2 mm., branching at intervals of 2-7 mm. or more, irregularly alternate, the branches lying for the most part in one plane; blade margins provided with usually prominent, regularly spaced teeth; axes showing a prominent midrib in lower parts, often becoming obscure in upper parts; spermatangia in small elliptical or linear sori on tips of segments or on small proliferous outgrowths; cystocarps scattered on both surfaces, projecting, ostiolate; tetrasporangia in rounded sori on blade tips or in small proliferous branchlets.

TYPE: An Anderson collection in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: Santa Cruz, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Cooper 866, Dawson 189, 240, 272, 8039 (Hubbs), vic. of Punta Descanso; D. 1264 (Johnson) Bahia Soledad; D. 9746 (Hubbs) Punta Banda; D. 9691, outer peninsula of San Quintin; D. 1264, 1137, 8672, 8865, Punta Baja; D. 8370, Isla Guadalupe; D. 9834, Isla Cedros; D. 10347, Punta Eugenio; D. 9101, Islas San Benito; D. 9231, Punta Pequeña, Bahia San Juanico; D. 9038, 9263, 9356, Isla Magdalena (ocean side).

Several of these specimens, especially those from Punta Pequeña (pl. 42. fig. 1) and some from Isla Magdalena, are of an exceedingly narrow form in which the blades are linear, only 1.5-2 mm. wide and the teeth proportionally very prominent.

### Tentative Working Key to the Species of *Phycodrys*

1. Plants 10-22 high, the blades usually with marginal branches or lobes which grow out to form segments ..... 3
1. Plants smaller (3-5 cm.) the blades simple (or with occasional proliferous marginal bladelets, in *P. profunda*) ..... 2
2. Blade margins smooth .....  
..... *P. simplex* sp. nov. (Gulf of Calif.)
2. Blade margins denticulate, some of the teeth growing out into rhizoids .....  
..... *P. profunda* sp. nov. (Calif. and N.W. Mexico)
3. Blade margins smooth ..... 4
3. Blade margins  $\pm$  prominently denticulate, dentate or serrate, at least in part ..... 6
4. Alae becoming bullate in age; vegetative regeneration by "budding"; reproduction unknown .....  
..... *P. bullata* Gardner (Alaska)
4. Not as above ..... 5
5. Tetrasporangia forming an irregularly continuous marginal band ..... *P. ambigua* Gardner (Alaska)
5. Tetrasporangia borne in paired, elongate patches on either side of midrib of ultimate segments .....  
..... *P. elegans* Setch. & Gard. (Galapagos Isl)<sup>4</sup> 4
6. Plants abundantly proliferous from midribs as well as margins ..... *P. austrogeorgica* Skottsberg (So. Georgia)
6. Plants not abundantly proliferous from midrib, although sometimes  $\pm$  marginally proliferous ..... 7

<sup>4</sup>When Taylor (1945, p. 279) described *Phycodrys pulchra* he said: "They differ [from *P. elegans* S. & G.] in minor respects [and] may prove to be nothing more than a particularly luxuriant variety [of that]." His fine array of Galapagos specimens appear to me to be completely identical with the tetrasporangial Setchell and Gardner material, and a further Galapagos collection (AHF 66-33) that is intermediate between the broad plants of Taylor and the narrow type of *P. elegans*, allows me to make this reduction without hesitation.

7. Tetrasporangia produced mainly in small sori scattered between or along the nerves ..... 9
7. Tetrasporangia borne in small marginal proliferations ..... 8
  8. Veins narrower, strongly marked; color brownish red.....  
..... *P. antarctica* (Skottsberg) Skottsberg (Grahamsland)
  8. Veins broader, less strongly marked; color reddish .....  
..... *P. sinuosa* (Huds.) Kütz. (North Atlantic)
9. Marginal teeth 2-3 mm. long, very prominent .....  
..... *P. riggii* Gardner (Alaska)
9. Marginal teeth short, not so prominent ..... 10
  10. Blades exceedingly ample, broader than long .....  
..... *P. amplissima* sp. nov. (Gulf of Calif.)
  10. Blades or segments not particularly ample, usually distinctly longer than broad ..... 11
11. Marginal teeth often developing into bundles of rhizoids; tetrasporangia in very small (250-350  $\mu$ ) scattered sori in the alae ..... *P. lucasana* sp. nov. (So. Baja Calif.)
11. Marginal teeth not developing into bundles of rhizoids; tetrasporangial sori larger ..... 12
  12. Tetrasporangia in irregular patches along veins in main blades ..... *P. fimbriata* (De la Pyl.) Kylin (subarctic)
  12. Tetrasporangia in scattered sori between the side nerves 13
13. Blades more undulate, broader .....  
..... *P. setchellii* Skottsberg (Pacific North America)
13. Blades less undulate and denticulate, more lingulate .....  
..... *P. quercifolia* (Bory) Skottsberg (Falkland Isl.)

**Phycodrys lucasana** sp. nov.

Pl. 37, fig. 7-8; Pl. 43, fig. 1

Thalli ad 5 cm. alt., delicate membranacei, ex una lamina ramosa infra stipitem brevem (2 mm.) teretem admodum contantes; lamina primaria ad 13 mm. lat., lanceolata, costam tenuem (100-150  $\mu$ ) sed manifestam, necnon nervos tenuissimos oppositos, e duobus ordinibus cellularum plerumque constantes, praebens: margines primum valde denticulati, aliquibusdam dentium in fasciculos rhizoideorum teretes simplices ramososve effectis, aliis ramos, ad basim latos, laminae primariae similes plerumque formantibus; tetrasporangia in soris parvis sparsis punctatis in alis laminarum nata, soris 250-350  $\mu$  diam., 25-35 sporangia habentibus; reproductio sexualis non visa.

Thalli to 5 cm. tall, delicately membranous, consisting essentially of a single branched blade below a short (2 mm.) terete stipe; primary blade to 13 mm. wide, lanceolate, with a slender (100-150  $\mu$ ) but distinct midrib and very slender, opposite nerves mostly of two cell rows; margins at first strongly denticulate, some of the teeth developing into terete, simple or branched rhizoid bundles, others forming usually broad-based branches similar to the primary blade; tetrasporangia borne



in small scattered punctate sori on the alae of the blades, the sori 250-350  $\mu$  in diam., with 25-35 sporangia; sexual reproduction not seen.

TYPE: Holotype is E. Y. Dawson 6808, March 11, 1949, in Herb. A. Hancock Foundation.

TYPE LOCALITY: Dredged in 36 m., Bahía de San Lucas, Baja California, Mexico.

The distinctive features of this species are the small size, the very short, terete stipe, delicate midrib, very small, punctate tetrasporangial sori, and the development of the marginal teeth into rhizoidal processes. The secondary blades are little contracted at their bases and give somewhat the impression of extended lobes. There is little evidence of erosion of the blades down to the midrib to form pseudostipitate segments as in various other members of the genus.

### ***Phycodrys setchellii* Skottsberg**

Pl. 45, fig. 1

Skottsberg 1922, p. 433, pl. 50. Dawson 1945a, p. 102; Dawson 1945, p. 62.

Thalli 10-12 cm. tall, pinkish-red, consisting of pinnately branched and lobed membranous leaf-like blades from a discoid holdfast; blades long-elliptical to obovate, to as much as 2 cm. wide, monostromatic except at the percurrent midrib and the subopposite veins, becoming lobed and oppositely branched by lateral, marginal growth from the veins so that the veins become midribs, becoming eroded below and the midribs persisting as stipes and axes which may become decumbent; margins  $\pm$  undulate, smooth or irregularly dentate, or with proliferous branchlets; tetrasporangia and spermatangia formed in small, scattered sori between the veins over entire monostromatic portion, or the tetraporic sori filling small, flat, marginal leaflets; cystocarps not seen.

TYPE: Farlow, Anderson & Eaton Alg. Exsicc. Amer. Bor. no. 65 (copy in Herb. Botanical Garden, Gothenburg, Sweden).

TYPE LOCALITY: Fort Point, San Francisco, Calif.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 6489, Bahía Colnett (drift); D. 181, Rio San Telmo (drift); D. 8770, outer peninsula of San Quintín (drift); D. 9035, Arrecife de Sacramento, 60 m.; D. 8279, Isla Guadalupe, 80-100 m.; Emery, May 1944, Canal de Kellett, off Isla Cedros, 40-50 m.; D. 9550, off Punta San Hipólito, 70 m.

### ***Phycodrys profunda* sp. nov.**

Pl. 37, fig. 3-6

Thalli parvi, c. 2-3 (5) cm. alt., constantes ex 1-3 laminis admodum simplicibus e stipite composito brevi (2-3(10) mm. per discum parvum succulentum affixo, orientibus; laminae oblanceolatae ad lineari-oblanceolatas, ad basim cuneatae, simplices aut laminula marginali interdum praeditae, ad 5-6 mm. lat. expansae, membranaceae, costam relative crassam (350-750  $\mu$ ) atque venas oppositas habentes; margines denticulati, nonnullis dentibus ad processus ad 3 mm. vel plus long. ramosos teretes, rhizoidea ferentes, formandos mox



elongatis, processibus organa affixionis secundaria arenae conchaeque affixa efficientibus; tetrasporangia duobus modis nata; in soris parvis rotundatis 250-400  $\mu$  diam., inter venas, atque in proliferationibus subteretibus stichidioformibus, e marginibus laminae orientibus; reproductio sexualis non visa.

Thalli small, about 2-3 (5) cm. tall, consisting of 1-3 essentially simple blades from a short, compound stipe (2-3 (10) mm.) attached by a small, fleshy disc; blades oblanceolate to linear-oblanceolate, cuneate to the base, simple or with an occasional marginal bladelet, expanding to 5-7 mm. wide, membranous, with a prominent, relatively coarse (350-750  $\mu$ ) midrib and opposite veins; margins denticulate, some of the teeth often very soon elongating to form branched, terete, rhizoid-bearing processes to 3 mm. long or more, forming secondary attachments to sand and shell; tetrasporangia borne in two ways: in small rounded sori 250-440  $\mu$  in diam. between the veins, and also in subterete, stichidium-like proliferations from the blade margins; sexual reproduction not seen.

TYPE: Holotype is E. Y. Dawson 5519, Oct. 31, 1948, in Herb. A. Hancock Foundation.

TYPE LOCALITY: Dredged in 60 m., 1 mi. e. of White Cove, Santa Catalina Island, Calif., on brachiopod bottom.

ADDITIONAL MATERIAL: Dawson 8456, Melpomene Cove, Isla Guadalupe, dredged in 90 m., coarse sand, Dec. 19, 1949.

These two collections show the distinctive characters of this species quite well: small size, mostly simple, elongate blades with prominent rhizoidal development of part of the marginal teeth, and dimorphic tetrasporangial sori. The rhizoidal processes are much like those of *P. lucasana*, although more extensive, but in other features the plants are dissimilar.

*Phycodrys radicata* (Okamura) Yamada & Inagaki, in Yamada 1933, p. 283, is similar in many respects, but that plant was originally described as consisting of "2 layers of cells; the inner, of oblongo-angular, larger, colorless, empty cells with thickish walls; the cortical, of angular, flattish cellules." This character should be verified, for it would remove the plant from *Phycodrys*.

#### *Phycodrys simplex* sp. nov.

Pl. 38, fig. 2-3

Thalli 4-5 cm. alt., e aliquot laminis simplicibus, stipitem brevem (3-5 (10) mm., habentibus, e stipite communi tereti 5-10 mm. long, ramosis, constantes: laminae lanceolatae, sine ramis lobisve, invenales anguste cuneatae ad basim. adultae latiores 1-2.5 cm. lat., costam manifestam, ad basim ad 1 mm. lat., nec non venas oppositas tenues inconspicuas habentes; margines leves, paululum undulati; reproductio non visa.

Thalli 4-5 cm. high, consisting of several short-stipitate (3-5 (10) mm.) simple blades branching from a terete common stipe 5-10 mm. long; blades lanceolate, without branches or lobes, basally narrowly

cuneate in youth, becoming broader in age, 1-2.5 cm. wide, with a prominent midrib to 1 mm. wide at the base and with slender, faint, opposite veins; margins smooth, slightly undulate; reproduction not seen.

TYPE: E. Y. Dawson 183-40, Jan. 26, 1940, in Herb. A. Hancock Foundation.

TYPE LOCALITY: Dredged in 22-44 m., Puerto Refugio, Isla Angel de La Guarda, Gulf of California, Mexico.

ADDITIONAL MATERIAL: Dawson 276-40, Jan. 28, 1940, dredged in 12-22 m., Mejia Channel, Puerto Refugio, Isla Angel de la Guarda.

These two collections appear to represent an undescribed species despite the lack of reproductive characters. The consistently simple, smooth-margined, sharply lanceolate blades (where undamaged) and the branching only from the terete stipe set them apart from the other known species in the key. The plant seems also to be small of stature, but maximum size cannot be judged from the present materials.

*Phycodrys amplissima* sp. nov.

Pl. 44; Pl. 45, fig. 2-3

Thalli 10-13 cm. alt., constantes e laminis una vel aliquot membranaceis late expansis undulatis, e stipite brevi (5-8 mm.) per hapteron discoideum affixo, orientibus: laminae latiores quam altae (ad 20 cm. lat.) amplae undulataeque asymmetricae late lobatae, nisi ad venas monostromaticae, costam incrassatam necnon venas oppositas ad suboppositas, in partibus inferioribus mediisque prominentes, habentes; venae ad basim plus quam 1 mm. lat., supra gradatim minuentes, nonnullae nervi laterales aequae prominentes ac costae factae, nervos irregulares hic illic plerumque anastomosantes vicissim ferentes; margines laminae ubique minute denticulati; spermatangia maculas rotundatas irregularesve 1-2 mm. diam. in alis inter venas formantia; cystocarpi 600-750  $\mu$  diam., rostrati, per laminam totam inter venas sparsi; tetrasporangia non visa.

Thalli 10-13 cm. tall, consisting of 1 or a few membranous, broadly expanded, undulate blades from a short (5-8 mm.) stipe attached by a discoid holdfast; blades broader than tall (to 20 cm. broad) ample and undulate, asymmetrical, broadly lobed, monostromatic except at the veins; a thickened midrib and opposite to subopposite nerves prominent in lower and middle parts, these more than 1 mm. wide at their bases, fading gradually above, some of the side nerves becoming as prominent as the midrib and they, in turn, bearing irregular nerves that tend to anastomose here and there; blade margins minutely denticulate throughout; spermatangia forming rounded or irregular patches 1-2 mm. in diam. in alae between veins; cystocarps 600-750  $\mu$  in diam., rostrate, scattered over entire blade between the veins; tetrasporangia not seen.

TYPE: Holotype is California Department of Fish and Game, Jan. 26-27, 1960. (E.Y. Dawson 21580) in Herb. Beaudette Foundation. Isotypes are in Herb. A. Hancock Foundation and in Herb. University of California, Berkeley.

TYPE LOCALITY: From a depth of 10-36 m., off Isla San Esteban, Gulf of California, Mexico.

The ample sexual material of this plant shows it to be one of the very distinctive members of the genus. Structure of the apex characteristic of *Phycodrys* is seen in juvenile bladelets from the base of the main stipe, since apical parts of older blades become eroded. It is the broadest species yet described. The venation becomes so complex in older blades that a fragment alone suggests the genus *Polyneura*.

***Polycoryne gardneri* Setchell**

Pl. 39, fig. 6

Setchell 1923, p. 395; Wagner 1954, p. 317, fig. 159-162, 164-175. *Polycoryne phycodricola* Dawson 1945, p. 107, pl. 20, fig. 4-5.

Thalli parasitic on *Phycodrys* and *Nienburgia*, pale or colorless, at first a solid, short-cylindrical or hemispherical body with short, horn-like protuberances, becoming a cluster of club-like branches about 3 mm. in diam, or more attached by processes that penetrate the host; branches somewhat crooked,  $\pm$  terete, about 1 mm. long or a little more, growing by means of an apical cell; spermatangia forming a continuous sorus over surface of branches; cystocarps developing singly on branches; tetrasporangia forming a continuous sorus on fertile branch surfaces.

TYPE: N. L. Gardner 2594, October 1913, in Herb. University of California, Berkeley.

TYPE LOCALITY: Point Cavallo, Marin Co., California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—Emery, May 1944, Canal de Kellett, off Isla Cedros, on *Phycodrys setchellii*, 40-50 m.

Wagner has pointed out that seemingly identical examples of this plant occur both on *Phycodrys* and on *Nienburgia*, and she has suggested that *P. gardneri* and *P. phycodricola* are probably conspecific. The writer now concurs and makes this reduction pending critical comparisons of the plants on the different hosts.

***Haraldia prostrata* Dawson, Neushul & Wildman**

Pl. 45, fig. 5-7

Dawson, Neushul & Wildman 1960a, p. 25, pl. 2, fig. 4-6.

Thalli small, membranous, to about 1.5 cm. broad or long, largely prostrate and the blades overlapping, attached to various objects and to blades of its own by groups of rhizoids from the tips, margins or under surfaces of the thallus; blades mostly broadly expanded and markedly undulate, irregularly pinnately or flabellately short-branched or lobed, the margins provided with teeth, monostromatic throughout vegetative parts, without veins; apices acute; cells in central vegetative parts polygonal, mostly 50-60  $\mu$  in diameter; tetrasporangia borne in prominent, solitary, rounded sori, each occupying a large area near the end of an ultimate branch; sexual material not seen.

TYPE: Dawson 20292a (Neushul), Aug. 13, 1957, in Herb. Beaudette Foundation.

TYPE LOCALITY: At a depth of 60-75 ft., Islas San Benito, Baja California, Mexico.

Known only from the type.

***Anisocladella pacifica* Kylin**

Pl. 45, fig. 8-9

Kylin 1941, p. 31, pl. 11, fig. 29; Dawson 1945d, p. 63; Dawson 1949, p. 223; Dawson 1951a, p. 53; Dawson, Neushul and Wildman 1960, p. 44

Plants growing in sandy turfs with other small algae, consisting of prostrate flattened axes attached by rhizoids and discs and giving rise to several erect, ligulate, red blades 1-3 (6) cm. tall, 2-4 mm. wide; prostrate axes freely branched, the branches opposite but appearing alternate and irregular because most of them are reduced to a midrib or to spines; blades terminally obtusely pointed, basally short-stipitate, with few or many marginal teeth often of two sizes, monostromatic except at the prominent, percurrent midrib and the more-or-less-evident, sub-opposite, diagonal, unbranched nerves; tetrasporangial sori in upper part of erect blades, forming elongate, lenticular patches extending half way or more from midrib to margin; sexual material not seen.

TYPE: G. M. Smith, Oct. 29, 1940, in Herb. Agardh, Lund, Sweden.

TYPE LOCALITY: At 0.0 foot tide level, partly buried in sand, Asilomar, near Pacific Grove, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 253, 8 km. so. of Punta Descanso; D. 91, 6490 (7-12 m.), Cabo Colnett; D. 1201, 8099, Punta Baja; D. 10080, 11 mi. w. of Punta Malarrimo; D. 9488, Punta Abreojos; D. 9200, Bahía Asunción.

This species is most common as a member of the undergrowth turf in the *Phyllospadix* community at lowest intertidal levels.

***ErythroGLOSSUM californicum* (J. Agardh) J. Agardh**

Pl. 46, fig. 1

J. G. Agardh 1898, p. 176; Kylin 1941, p. 31, pl. 10, fig. 28. *Delesseria californica* J. G. Agardh 1884, p. 69.

Thalli 3-4 cm. tall, consisting of a few erect, ligulate blades from a branched, terete stipe attached by a disc; blades delicate, 2.5-3.0 mm. broad, mostly simple, with an evident, percurrent midrib, but without side nerves; margins minutely, sometimes faintly, denticulate; tetrasporangia forming small, anastomosing sori between the blade margins and the midrib; sexual material not seen.

TYPE: Not specifically designated, consisting of two specimens on one sheet in Herb. Agardh, Lund, Sweden.

TYPE LOCALITY: Not specifically designated, the two specimens:



Nr. 31387 "California, Farlow," Nr. 31388 "Santa Barbara [California] L. N. Dimmick" (illustrated by Kylin.)

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 13389,  $\frac{1}{4}$  mi. off Punta Entrada, Isla Magdalena, 26 m.

***Acrosorium uncinatum* (Turner) Kylin**

Pl. 43, fig. 2

Kylin 1924, p. 78; Taylor 1945, p. 285; Dawson 1945d, p. 63, 67; Dawson, Neushul & Wildman 1960, p. 38, pl. 34, fig. 1. *Fucus laceratus* var. *uncinatus* Turner 1808, p. 153, pl. 68, fig. c-d.

Thalli usually epiphytic or entangled, or attached to pebbles or shell fragments by rhizoids, rose red, 2-5 cm. tall, bushy when amply developed, consisting of irregularly branched ligulate, membranous blades 1-2 mm. wide with entire margins; blades with subacute tips and usually with strongly hamate branchlets, with a system of microscopic nerves in the otherwise monostromatic blade; reproduction by fragmentation and reattachment, or, in the Pacific Coast plants, exceedingly rarely by tetrasporangia (observed only once among many hundreds of specimens).

TYPE: A collection by "Miss Hill" probably to be found among the Dawson Turner materials in the Herbarium at Kew or in the British Museum.

TYPE LOCALITY: Tenby, England.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 7909 (Hubbs) Tijuana Slough; D. 7950 (Hubbs) Islas Coronados; D. 8041 (Hubbs) Bahía Descanso; D. 19214 (Norris) Punta Banda; D. 8253, 8271 (45-55 m.), 8278, 8488 (75-100 m.), 8444 (95 m.), 19233 (Limbaugh & Chester 20-25 m.), 19291 (Hubbs) Isla Guadalupe; D. 20449 (Neushul, 18 m.), D. 6558 (38 m.) Isla Cedros; D. 7891 (Osorio-Tafall) Isla Natividad; D. 20287 (Neushul, 20-25 m.) Islas San Benito; D. 20476 (Neushul, 35 m.), 20495 (Neushul, 10-15 m.) southern Bahía Viscaíno; D. 20842 (Neushul) Punta Eugenio; D. 20576 (Neushul) Bahía Tortuga, 11-15 m.; D. 20378, 20420, 20428a (Neushul, 10-12 m.) Isla Asuncion; D. 13249, Punta Pequeña; D. 20344 (Neushul, 8 m.), D. 20358 (Neushul, 20 m.), D. 7904, Bahía San Hipólito; D. 7277, 7249, (3 m.), Taylor 34-605, Bahía Santa María; D. 20202 (Neushul 15 m.), D. 6607, 6608 (25 m.), D. 13386 (26 m.) Punta Entrada, Isla Magdalena; D. 6723 (35 m.) Isla Margarita; D. 13342, Punta Lobos; D. 6876 (38 m.) Bahía San Lucas.

**Key to the Mexican Species of *Myriogramme***

1. Thalli 10-20 cm. tall ..... *M. spectabilis*
1. Thalli 3 cm. tall or less ..... 2
  2. Plants with densely congested, ruffled blades joined together by accessory attachment discs ..... *M. caespitosa*
  2. Plants not as above, the blades essentially free ..... 3

- 3. Blades divaricately dichotomously branched ..... *M. divaricata*
- 3. Blades simple or lobed ..... 4
- 4. Tetrasporangial sori minute, scattered over entire blade.....  
..... *M. hollenbergii*
- 4. Tertasporangial sori large (to 4 mm. in diam.) occupying  
most of the middle and upper blade areas ..... *M. osorioi*

### *Myriogramme hollenbergii* Kylin

Pl. 46, fig. 5-7

Kylin 1941, p. 32, pl. 11, fig. 30; Smith 1944, p. 346, pl. 88, fig. 2-4; Dawson 1951, p. 53.

Thalli 1-2 cm. tall, bright red, with a disc-shaped base supporting a short stipe, the stipe terminating in a blade and at times bearing lateral blades; blades 5-10 mm. tall, 2-3 (5) mm. broad, narrowly to broadly ovate, at times with one or two incisions at the apex, monostromatic throughout, without veins; spermatangial sori lunate, on upper part of blade; cystocarps usually limited to two or three on a blade; tetrasporangial sori minute, irregularly shaped, scattered over entire blade.

TYPE: A collection by G. J. Hollenberg, July 18, 1939, in Herb. Agardh, Lund University, Sweden.

TYPE LOCALITY: On piling, Municipal pier, Monterey, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 8001, Cortez Bank, off California-Mexico boundary, 27-35 m.; D. 9276, Punta Entrada, Isla Magdalena (corresponds except for numerous cystocarps scattered over blades and somewhat less prominent stipe than the type).

### *Myriogramme spectabilis* (Eaton) Kylin

Pl. 46, fig. 2

Kylin 1924, p. 58; Dawson 1949, p. 223. *Nitophyllum spectabile* Eaton 1877, p. 245.

Thalli usually epiphytic, 10-20 cm. high, rose-red, consisting of a prostrate system bearing erect, short-stipitate blades; blades narrowly fan-shaped to irregularly palmately incised into ligulate segments 5-10 mm. broad or more, without midrib or veins, the margins entire, seldom proliferous, the apices blunt and rounded; spermatangia in areolate patches; cystocarps scattered irregularly over both surfaces of blades, 500-600  $\mu$  in diam.; tetrasporangial sori small, elliptical, closely spaced over blade surfaces.

TYPE: An Anderson collection presumably in the Farlow Herbarium, Harvard University.

TYPE LOCALITY: Santa Cruz, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 6486, Bahía Colnett (7-12 m.); D. 5172, Cabo Colnett; D. 9648, 9681, peninsula of San Quintin; D. 2755, Socorro, north of Punta Baja; D. 8446, Isla Guadalupe 90 m. (an atypical, deep-water form)

**Myriogramme caespitosa** Dawson

Pl. 47, fig. 4

Dawson 1949, p. 19, fig. 8; Dawson, Neushul &amp; Wildman 1960a, p. 26.

Thalli caespitose, about 1 cm. high, densely, congestedly branched from the base, consisting of several thick, membranous, essentially non-stipitate blades arising from a small, irregularly fleshy holdfast, the blades joined together by small accessory attachment discs; blades ruffled and lobed, 5-8 mm. broad, with smooth margins and rounded terminal lobes, unistratose except in basal parts, the thallus cells angular, 25-50 (70)  $\mu$  in diam. as seen in surface view; cystocarps 250-400  $\mu$  in diameter, with a conspicuous, rostrate ostiole.

TYPE: Hubbs 47-96d, April 30, 1947, in Herb. A. Hancock Foundation (26867).

TYPE LOCALITY: On the holdfast of *Macrocystis* found floating in San Miguel Passage off Santa Rosa Island, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 20400, Isla Asunción, 6-12 m.; D. 20190a (Neushul), off Punta Entrada, Isla Magdalena, 13 m. (Both these collections were growing on *Macrocystis* holdfasts.)

**Myriogramme osorioi** Dawson

Pl. 47, fig. 1-2

Dawson 1950a, p. 158, fig. 18-19.

Thalli caespitose, to 3 cm. high, from a clasping, branched, dactyloid holdfast from which arise 1 to several stipes about 800  $\mu$  in diam., in turn giving rise 3-5 mm. above the bases to expanded, broad, membranous blades, palmately deeply divided, the lobes mostly 4-5 mm. broad, entire, but commonly lacerated; stipe extending as a midrib only a little way, then fanning out and fading in the lower part of the blade; blades monostromatic in upper parts and at the margins, 50  $\mu$  thick, di-tetrasromatic below and in the middle (extension of the stipe), broadly rounded at the apices, without microscopic veins; growth marginal by means of a group of apical initials; cells in surface view mostly elongate-polygonal, 20-40  $\mu$  in greatest diameter; secondary blades stipitate, orbicular at first, arising from the margins, the stipes, or from the surface of the thickened mid-portions at the base of primary blades; tetrasporangia borne on one side of the blade in large, circular or oval sori to 4 mm. in diam., occupying most of the middle and upper blade area; sexual plants unknown.

TYPE: Dawson 737, Feb. 18, 1946, in Herb. A. Hancock Foundation.

TYPE LOCALITY: Intertidal rock crannies, northeast side of Isla Patos, Sonora.

MEXICAN DISTRIBUTION: *Gulf of Calif.*—D. 1009, Isla Partida.

**Myriogramme divaricata** Dawson

Pl. 40, fig. 5; Pl. 42, fig. 2

Dawson 1944, p. 323, pl. 47, fig. 5

Thalli to 3 cm. high, membranous, from a small, semi-rhizoidal holdfast below a solid, stipitate base 1 mm. or less in extent; blades proliferous only from lowest parts, abruptly divaricately dichotomously branched, lacking a midrib, with broad, short, veinless, monostromatic segments; axils of segments rounded, not angular; apical margins multilobate, the lobe often appearing truncate; growth from apical margins, without a terminal cell; tetrasporangia in small sori scattered through middle and upper portions of blades; sexual plants unknown.

TYPE: Dawson 181-40, Jan. 28, 1940, in Herb. A. Hancock Foundation (59).

TYPE LOCALITY: Dredged in 22-44 m., Puerto Refugio, Isla Angel de la Guarda, Gulf of Calif.

Known only from the type.

**Working Key to the North Pacific Species of *Cryptopleura***

1. Thallus diminutive, the free branches under 2 cm. long ..... 2
1. Thallus larger, the free parts 3-25 cm. long ..... 4
  2. Thalli epiphytic, largely prostrate, the free branches mostly rounded and lobed, less than 1 cm. long, to 3 mm. broad.....  
..... *C. corallinara*
  2. Thallus saxicolous, or apparently so ..... 3
3. Branches free, dichotomously branched, very narrow (1 mm. wide); reproduction unknown ..... *C. dichotoma*
3. Blades superimposed, prostrate with only the tips free, broadly lobed (4-6 mm.); tetrasporangial sori on terminal lobes .....  
..... *C. imbricata*
4. Upper segments narrow, linear, only about 1 mm. broad ....  
..... *C. hayamensis*
4. Upper segments mostly 4-10 mm. broad or more ..... 5
5. Thalli epiphytic or usually so; tetrasporangia borne in crisped marginal proliferations forming a fringe on mature segments ....  
..... *C. crispa*
5. Thalli usually saxicolous or at least not primarily epiphytic .... 6
  6. Thallus thin and papery, monostromatic in upper parts except at veins ..... *C. spatulata*<sup>5</sup>
  6. Thallus not so thin, mostly or wholly plurostromatic ..... 7

<sup>5</sup>Two southeastern Pacific species of *Cryptopleura* are known from Peru, both of them monostromatic between the veins. *C. cryptoneurum* (Mont.) Taylor resembles both *C. spatulata* and *C. violacea*. It has the sori on the main blades forming linear marginal bands extending the length of several segments, the same as in some specimens of *C. violacea*. *C. peruviana* Taylor seems to be more like *C. lobulifera* with a lobing and ruffling of midparts of the thallus and the tetrasporangial sori on these marginal ruffles or lobules.



7. Plants purplish olive to purplish red; 7-20 cm. tall ..... 8  
 7. Plants bright to dull red, large, coarse, to 20-30 cm. tall .....  
 ..... *C. ruprechtiana*  
 8. Blade margins variously ruffled and crisped; tetrasporangial  
 sori lunate to elliptical, just within margins of upper blades  
 or in marginal ruffles ..... *C. lobulifera*<sup>6</sup>  
 8. Blade margins usually not ruffled or crisped with lobes, but  
 sometimes so; tetrasporangia usually linear along margin of  
 upper segments, sometimes in proliferous bladelets as well....  
 ..... *C. violacea*

***Cryptopleura corallinara* (Nott) Gardner**

Pl. 49, fig. 1

Gardner 1927, p. 240; Dawson 1949, p. 223; Dawson 1957a, p. 8; Dawson, Neushul & Wildman 1960a, p. 26; *Nitophyllum corallinarum* Nott 1900, p. 24, pl. 3, fig. 10.

Thalli epiphytic, usually on articulated corallines, but on various other algae, small, both prostrate and erect (or at least free); prostrate thallus creeping, membranous, with microscopic veins, attached by rhizoids, the margins entire, lobed and branching, the branches becoming erect; erect parts much like the prostrate ones, flat, membranous, ovate-spatulate to elliptical, to 7 mm. tall, (rarely to 15 mm), 3 mm. broad, with microscopic veins, subdichotomously lobed or divided, the margins entire; tetrasporangia in sori of varying size and shape, but usually occurring as a large solitary elliptical or orbicular sorus occupying most of the ends of free segments; spermatangia in solitary, elliptical sori occupying all but margins of short free segments.

TYPE: A collection by Mrs. E. Snyder in Herb. Univ. California, Berkeley.

TYPE LOCALITY: San Diego [La Jolla] California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*—D. 4149 (Hubbs), 8147, 8555, 8327, 1926 (Hubbs) Isla Guadalupe; D. 1296, Punta Baja; D. 10552 Isla Cedros; D. 1457, Punta Santa Rosalía; D. 20280, 21278 (Neushul) Islas San Benito; D. 10033, 11 mi. w. of Punta Malarrimo; D. 10389 (male on *Codium*), D. 10363, 10399, Punta Eugenio; D. 20157 (Neushul) Punta Abreojos; D. 20354 (Neushul) Punta San Hipólito; D. 20245 (Neushul) Punta Hughes, Isla Magdalena; D. 16157 (Limbaugh) Rocas Alijos.

***Cryptopleura imbricata* sp. nov.**

Pl. 45, fig. 4; Pl. 48, fig. 1

Thallus saxicolus, ubique admodum prostratus, maculam tegitiformem 5 cm. vel plus extensam formans; thallus constans e 2-3 laminis superimpositis, brevilobatis, membranaceis, compositis, venas praebentibus, segmenta 4-6 mm. lat. habentibus; laminae per paxillos rhizoideos multos ad extremitatem discoideos

<sup>6</sup>*Cryptopleura membranacea* Yamada 1935a, p. 28, is closely related here, and it is not possible to determine from the original description how it differs.

substrato et inter se laxae affixae, segmentis ultimis aut lobis tantummodo liberis, margines laminae integri, aliquantulum undulati; segmenta terminalia late rotundata expansaque; sori tetrasporangiales late elliptici aut lenticulares, plerumque extermitates segmentorum terminalium latorum occupantes; plantae sexuales non visae.

Thallus saxicolous, essentially prostrate throughout, forming a mat-like patch 5 cm. or more in extent consisting of 2-3 superimposed, compound, short-lobed, membranous, veined blades with segments 4-6 mm. broad, attached loosely to the substrate and to each other by abundant rhizoidal pegs with discoid ends, only the ultimate segments or lobes free; blade margins entire, somewhat undulate; terminal segments broadly rounded and expanded; tetrasporangial sori broadly elliptical or lenticular, occupying most of the ends of the broad terminal segments; sexual plants not seen.

TYPE: Holotype is E. Y. Dawson 8879, January 2, 1950, in Herb. Beaudette Foundation.

TYPE LOCALITY: Intertidal, at the end of the Punta Baja headland, Baja California, Mexico.

PARATYPE: Ernst S. Reese BIT-4, Aug. 13-17, 1959, in runoff channel beneath rock wall, blow-hole at Papolote, Punta Banda, Baja Calif.

Three additional intertidal collections appear to belong here but are sterile and may possibly represent young stages of another species: D. 5961, Santa Cruz Island, Calif.; D. 8773, San Quintin peninsula, Baja Calif.; D. 13358, Punta Thurloe, Baja Calif.

The type specimen was at first taken to be a juvenile specimen of *Cryptopleura lobulifera*, but closer examination revealed the distinctive superimposed blades with their  $\pm$  appressed, short, fertile tetrasporangial lobes scarcely free from the prostrate vegetative parts.

### *Cryptopleura lobulifera* (J. Agardh) Kylin

Pl. 46, fig. 4

Kylin 1924, p. 90, fig. 75-76. *Neuroglossum lobuliferum* J. G. Agardh 1898, p. 121.

Thalli mostly 5-10 cm. tall, forming a bushy clump on the substrate, purplish-olive, consisting of a group of subdichotomously divided, membranous, erect branches whose segments diverge rather widely; segments 8-15 mm. broad, usually with the margins variously crisped and ruffled, the lower portions with a conspicuous midrib and with distinct veins above, the ultimate segments with microscopic veins; tetrasporangial sori lunate to elliptical, restricted to upper portion of segments, lying either just within the margins of segments, or in small, flat, proliferous outgrowths from the segment margins; spermatangial sori borne in compound, crisped marginal lobules; cystocarpic plants not seen.

TYPE: A single tetrasporangial plant in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: Pacific Grove, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*— Cooper 530a, 3/5/47, Playa Rosarita; D. 286, 4307, vicinity of Punta Descanso; D. 1138, 1301, 8878, Punta Baja; D. 1444, Punta Santa Rosalía.

This northern species appears to be confined in Mexico to the coldest upwelling areas of northwestern Baja California.

### *Cryptopleura spatulata* Gardner

Pl. 48, fig. 2

Gardner 1927, p. 241; Dawson 1960, p. 51.

Thalli 8-12 cm. tall or more, apparently usually saxicolous, membranous, consisting of irregularly subdichotomous to subpalmate branched or divided blades, the segments 7-12 mm. wide, 1.2 cm. long, without a midrib, but with microscopic longitudinal veins, monostromatic in upper parts except at the veins; tips rounded, sometimes broader just back of tips than a little lower down; margins entire or beset with small, elliptical, pedicellate, flat bladelets; tetrasporangia in small, rounded, solitary sori in marginal bladelets; sexual plants not seen.

TYPE: Mrs. H. P. Johnson 256, in Herb. University of California, Berkeley (94833).

TYPE LOCALITY: San Pedro, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*— D. 13231, Islas Todos Santos, 38 m.

Only a few other collections of this sublittoral species are known. Gardner recognized a collection from off Santa Barbara, and we have a recent tetrasporangial one from Goleta Pass, Calif., at a depth of 16.5 m. (D. 16020) that corresponds very closely with Gardner's specimens.

### *Cryptopleura crispa* Kylin

Pl. 49, fig. 2

Kylin 1924, p. 90, fig. 77; Dawson 1945, p. 67; Dawson 1950b, p. 68; Dawson 1951, p. 53; Dawson, Neushul & Wildman, 1950, p. 56.

Thalli epiphytic, consisting of a prostrate membranous system attached by rhizoids (this often several cm. in extent) giving rise to branched, ligulate free blades 3-8 cm. long or more and 3-4 mm. wide or more; blades at first prominently marginally undulate, then the undulations becoming congested, and crisped, at maturity showing a strong basal midrib (the blade margins often partly eroded away) and progressively fainter veins above; tetrasporangial and spermatangial sori borne in the crisped marginal processes; cystocarps irregularly scattered over the thallus surface.

TYPE: A collection by H. Kylin, June 1922, in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: La Jolla, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*— D. 84-45, 98-45, Punta Descanso (uncertain identification); D. 1111, Bahía de Todos



Santos; Gardner 4950, Ensenada; D. 85, 149, vic. Cabo Colnett; D. 1504, Punta Santa Rosalía; D. 9796, Isla Cedros; D. 9404, Islas San Benito; D. 6579, Bahía Tortuga; D. 9174, Bahía Asunción; D. 13-40, 16-40, 9339a, Bahía Santa María, Isla Magdalena.

***Cryptopleura violacea* (J. Agardh) Kylin**

Pl. 46, fig. 3

Kylin 1924, p. 89; Dawson 1945, p. 67; Dawson 1949, p. 223; Dawson, Neushul & Wildman 1960, p. 56. *Nitophyllum violaceum* J. G. Agardh 1876, p. 700.

Thalli mostly 10-20 cm. tall, purplish-olive to purplish-red, consisting of a small, prostrate, membranous epiphytic or saxicolous base giving rise to erect, stipitate, membranous, subdichotomous or irregularly divided blades; stipe extending into a  $\pm$  distinct midrib in lower blade parts, then into anastomosing veins extending to the apices of segments; segments ligulate, 5-10 (15) mm. broad, with broadly rounded apices, the margins often entire, sometimes with a few proliferous outgrowths; tetrasporangial sori usually linear and borne just within the blade margins of upper segments, sometimes extending 5-6 cm. along several segments, sometimes also borne on small proliferous bladelets from margins of segments; cystocarps to 1 mm. in diam., scattered irregularly over upper blade surfaces.

TYPE: According to Kylin, in the Agardh Herbarium, Lund, Sweden, under the name *Nitophyllum farlowianum* var.

TYPE LOCALITY: San Francisco, California.

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*— D. 158-45, Cooper 853, near Punta Descanso; D. 20904, 20940 (Neushul), cove n. of Punta Cabras; D. 9-45, 63, 70, 156, near Cabo Colnett; D. 1146b, 1135, 1228, 8671, nr. Punta Baja; D. 1553, near Punta María; D. 9483, Punta Abreojos; D. 7265, 9339, Punta Hughes, Bahía Santa María, Isla Magdalena.

***Botryoglossum farlowianum* (J. Agardh) DeToni**

Pl. 50

DeToni 1900, p. 676; Wagner 1954, p. 329; Dawson 1949, p. 223, Dawson, Neushul & Wildman 1960, p. 44. Dawson, Neushul & Wildman 1960a, p. 26. *Nitophyllum farlowianum* J. Agardh 1898, p. 95.

Thalli 10-30 cm. tall, bright red to purplish-red, consisting of several erect, branched, pseudostipitate, ligulate blades from an attachment of haptera; blades narrowly flabellate, subdichotomously branched, membranous, the segments 1-3 cm. broad, provided with numerous  $\pm$  longitudinal, anastomosing veins, sometimes with a central part of the vein system forming a midrib, the lower blade parts often eroding away to a pseudostipe of thickened veins; upper segments usually densely



fringed with  $\pm$  overlapping, semicircular or lobed marginal proliferous outgrowths; tetrasporangia borne in the lateral proliferations or sometimes in elongate sori on the thallus tip; spermatangial sori nearly covering marginal proliferations; cystocarps borne usually solitarily in the marginal proliferations.

TYPE: Probably to be found in the Agardh Herbarium, Lund, Sweden.

TYPE LOCALITY: "Coast of California."

MEXICAN DISTRIBUTION: *Pacific Baja Calif.*— D. 8040 (Hubbs). 5281, 190, 268, vicinity of Punta Descanso; D. 1105, Bahía de Todos Santos; D. 5159, Cabo Colnett; D. 138, Rio San Telmo; D. 8739, 1229, seaward Bahía de San Quintín; D. 1136, 1177, Punta Baja; Remple 2/28/37, Bahía Rosario; D. 20259 (Neushul) Arrecife de Sacramento.

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# PLATES

## PLATE 1

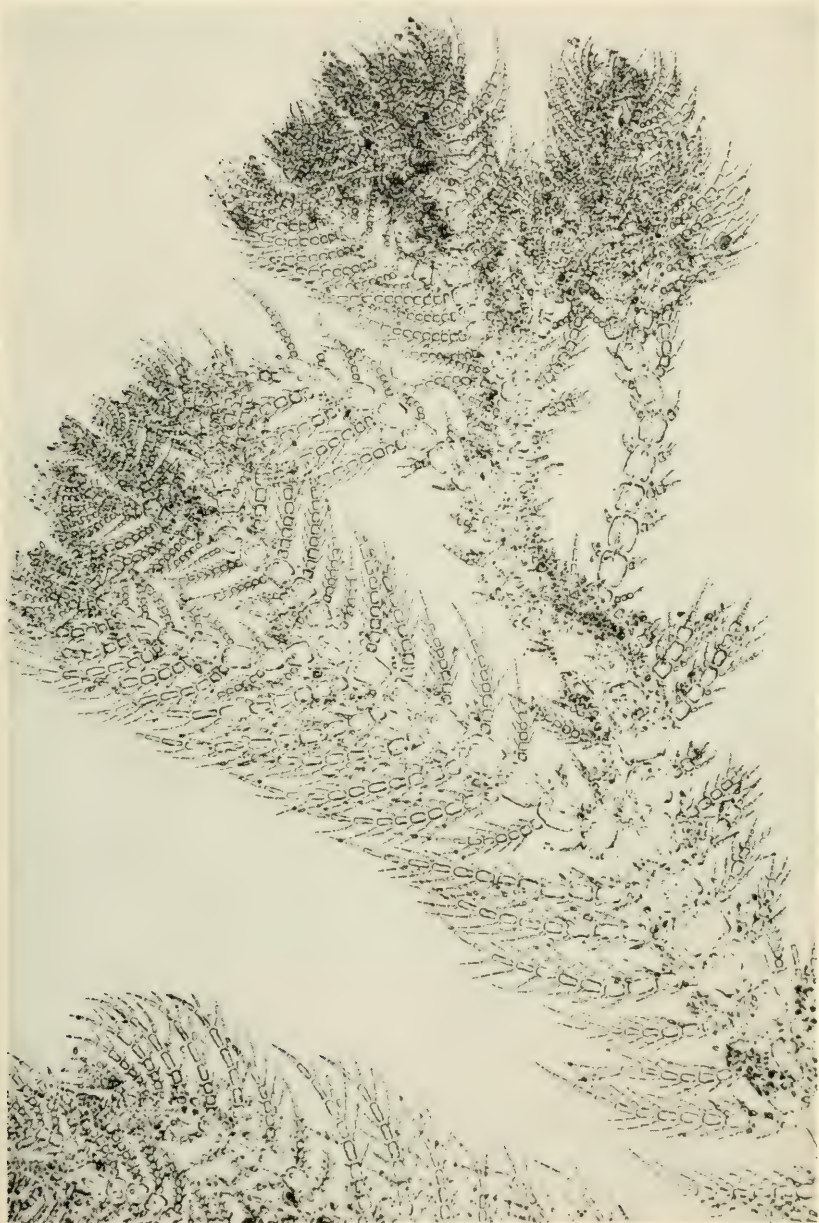
- Fig. 1-3. *Gymnothamnion elegans* (Schousb.) J. Ag.,  $\times$  94. Fig. 1-2, two axes with essentially simple pinnate branchlets and terminal sporangia; Fig. 3, a bipinnate axis with sporangia on the tertiary branchlets (after Feldmann-Mazoyer).
- Fig. 4 a-c. *Platythamnion pectinatum* Kylin. Fig. 4a, upper part of an axis,  $\times$  112; Fig. 4b, a growing tip,  $\times$  273; 4c, a carpogonial branch,  $\times$  370 (after Kylin).
- Fig. 4 d-f. *Platythamnion reversum* (Setch. & Gard.) Kylin. Fig. 4d, terminal portion of an axis,  $\times$  273; Fig. 4e, a carpogonial branch,  $\times$  370; Fig. 4f, portion of a mature tetrasporangial plant,  $\times$  112 (after Kylin).





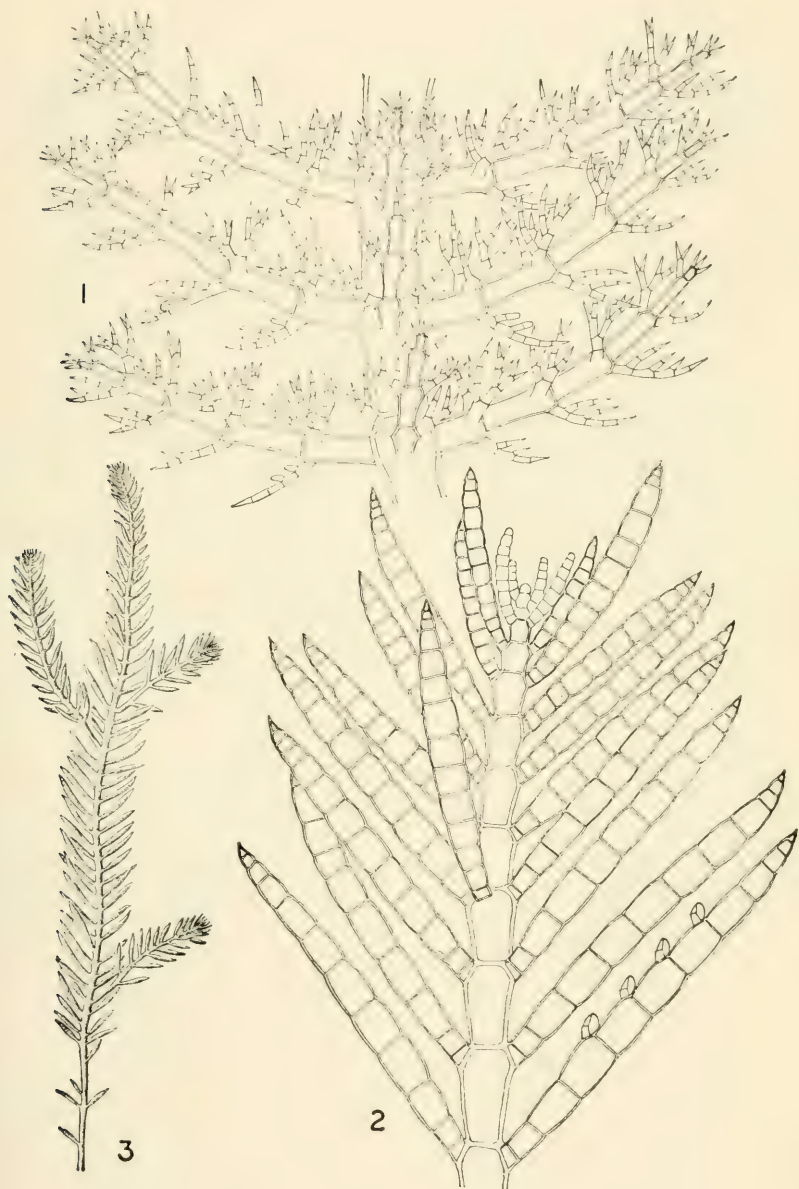
## PLATE 2

*Platythamnion tepocensis* Dawson. Photomicrograph of a portion of the type specimen.



## PLATE 3

- Fig. 1. *Platythamnion villosum* Kylin. Mid-portion of an axis,  $\times$  195 (after Smith).
- Fig. 2-3. *Antithamnion dendroideum* Sm. & Holl. Fig. 2, Upper part of a sterile plant,  $\times$  110; Fig. 3, An entire plant,  $\times$  5 (after Smith & Hollenberg).





## PLATE 4

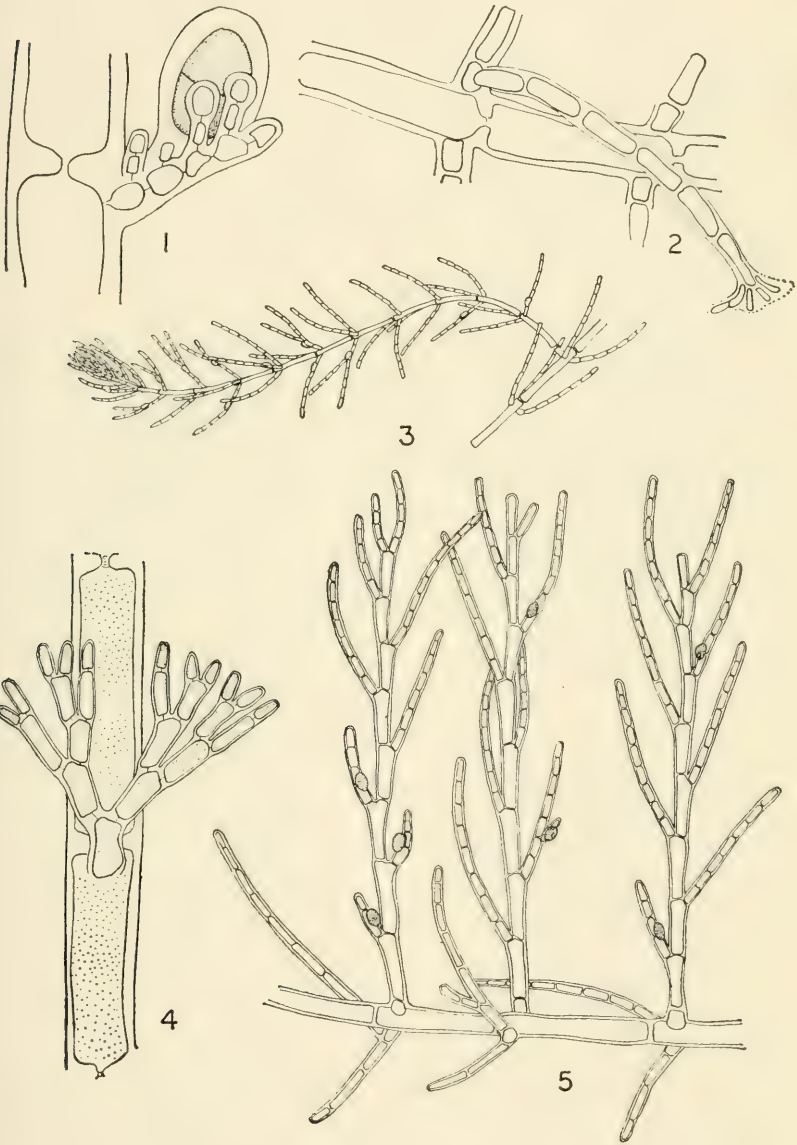
(all after Kylin)

- Fig. 1. *Platythamnion villosum* Kylin. A spermatangial branch,  $\times 122$ .
- Fig. 2-3. *Platythamnion pectinatum* Kylin. Fig. 2, part of a tetrasporangial plant,  $\times 87$ ; Fig. 3, a spermatangial branch,  $\times 200$ .
- Fig. 4. *Platythamnion heteromorphum* J. Ag. Part of a sterile axis,  $\times 85$ .
- Fig. 5-7. *Antithamnion glanduliferum* Kylin. Fig. 5-6, tetrasporangial branchlet,  $\times 112$ ; Fig. 7, mid-part of a sterile plant,  $\times 35$ .
- Fig. 8-9. *Antithamnion pacificum* (Harv.) Kylin, Fig. 8, mid-part of a sterile plant,  $\times 36$ ; Fig. 9 a tetrasporangial branch,  $\times 63$ .



## PLATE 5

- Fig. 1. *Antithamnion dendroideum* Sm. & Holl. A tetrasporangial branch,  $\times 340$ .
- Fig. 2. *Antithamnion hubbsii* sp. nov. Part of a lower axis showing a rhizoid,  $\times 206$ .
- Fig. 3. *Antithamnion breviramosus* var. *simplex* Daws. A sterile axis,  $\times 65$ .
- Fig. 4. *Antithamnion mcnabbii* Daws. Part of a mature axis showing only one of three whorled, lateral, determinate branches at a node,  $\times 305$ .
- Fig. 5. *Antithamnion lherminieri* (Cr. & Cr.) Nasr. Habit,  $\times 100$ .





## PLATE 6

- Fig. 1. *Antithamnion kylinii* Gard. Mid-part of a sterile plant showing an indeterminate branch with determinate branch opposite, adaxial secund branching of determinate laterals, and gland cells,  $\times 55$ .
- Fig. 2. *Antithamnion pygmaeum* Gard. Habit of a sterile plant showing indeterminate branches lacking opposite determinate branches,  $\times 55$ .
- Fig. 3. *Antithamnion hubbsii* sp. nov. Part of a sterile axis of the type collection,  $\times 42$ .
- Fig. 4. *Antithamnion plumulum* (Ellis) Thuret. Part of a tetrasporangial plant showing tendency toward *Platythamnion pectinatum*,  $\times 40$  (after Feldmann-Mazoyer).



## PLATE 7

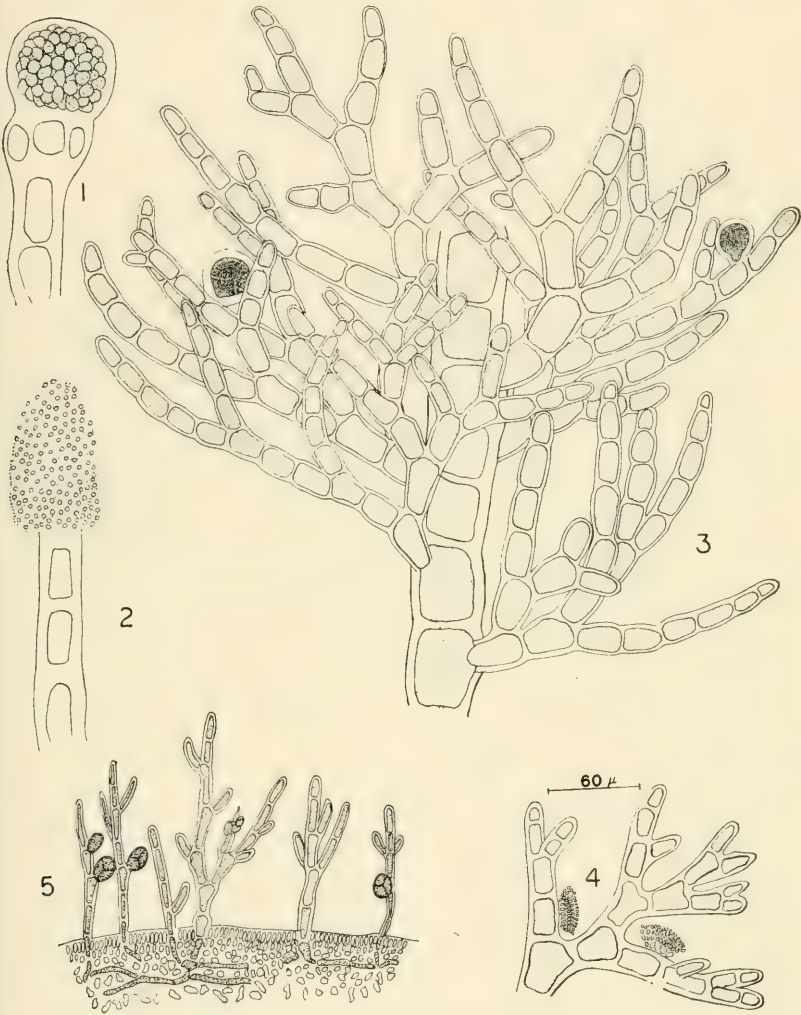
- Fig. 1, 5. *Antithamnion pseudocorticatum* sp. nov., from the type collection.  
Fig. 1, A young determinate branch showing pairs of adaxial branchlets from each basal cell. These produce cortication by continued growth,  $\times 600$ ; Fig. 5, a later stage showing clasping cortical filaments,  $\times 250$  .
- Fig. 2. *Antithamnion sublittoral* S. & G. part of a sterile plant,  $\times 60$ .
- Fig. 3. *Antithamnion secundatum* Gard. A mid-part of a sterile plant,  $\times 120$ .
- Fig. 4. *Crouania attenuata* (Ag.) J. Ag. Mid-part of a sterile plant,  $\times 170$ .





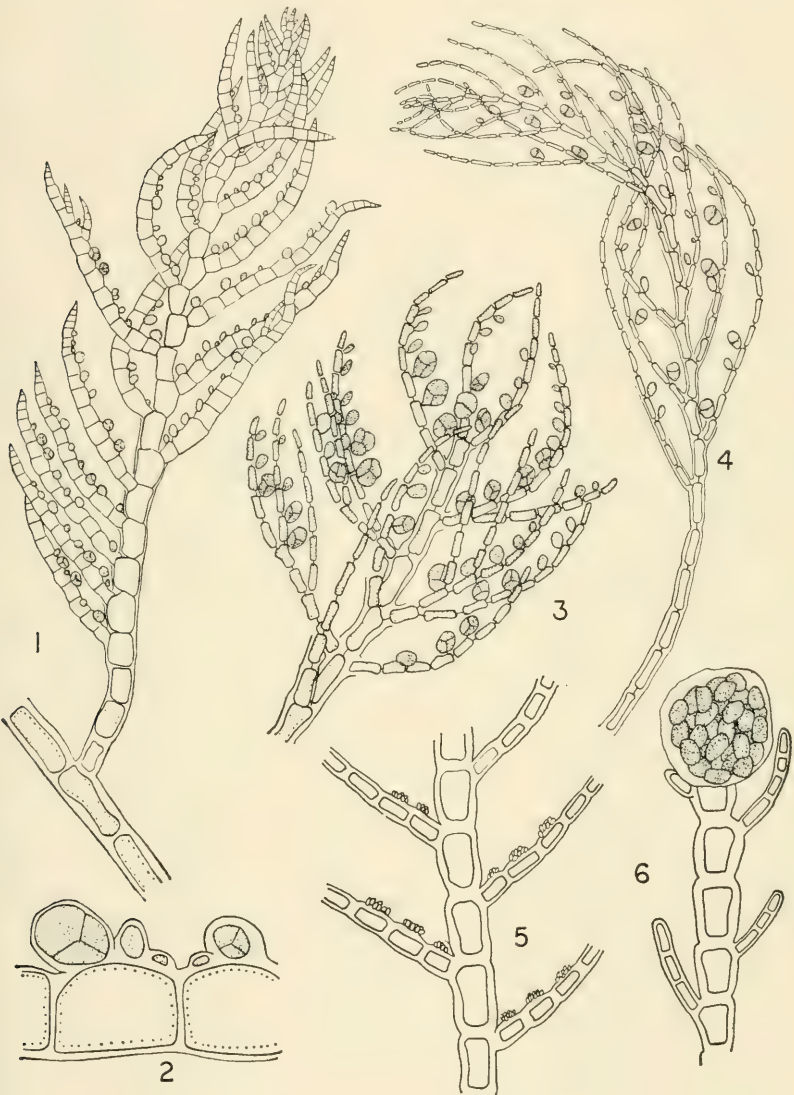
## PLATE 8

- Fig. 1-2. *Callithamnion lejolisea* Farlow. Fig. 1. A cystocarp terminating an erect branch  $\times 400$ ; Fig. 2, A capitate, terminal spermatangial cluster,  $\times 400$ .
- Fig. 3-4. *Callithamnion breviramosum* Gard. Fig. 3, Mid-portion of a tetrasporangial plant,  $\times 136$ ; Fig. 4, Spermatangial tufts.
- Fig. 5. *Callithamnion endovaginum* S. & G. Cystocarpic and tetrasporangial plants endophytic on *Grateloupia*,  $\times 135$ .



## PLATE 9

- Fig. 1-2. *Callithamnion catalinense* sp. nov., from the type collection. Fig. 1. Upper part of a tetrasporangial plant,  $\times 33$ ; Fig. 2, Detail of tetrasporangial branch,  $\times 211$ .
- Fig. 3. *Callithamnion compactum* sp. nov. Upper portion of the tetrasporangial type,  $\times 123$ .
- Fig. 4. *Callithamnion bisporum* var. *australe* var. nov. Upper part of the tetrasporangial type,  $\times 54$ .
- Fig. 5-6. *Callithamnion paschale* Borg. Upper portions of spermatangial and cystocarpic plants,  $\times 100$  and  $125$ , respectively.





## PLATE 10

- Fig. 1-3. *Callithamnion marshallense* Daws. Fig. 1, Branching habit  $\times 70$ , Fig. 2, A tetrasporangial branch,  $\times 162$ ; Fig. 3, A catenate holdfast,  $\times 60$ .
- Fig. 4-5. *Callithamnion rigidum* sp. nov., from the type collection. Fig. 4, Branching habit,  $\times 60$ ; Fig. 5, A tetrasporangial branch,  $\times 128$ .
- Fig. 6-7. *Callithamnion ramosissima* Gard., from D. 8566. Fig. 6, A tetrasporangial branch,  $\times 100$ ; Fig. 7, Apex of a growing plant,  $\times 210$ .



## PLATE 11

- Fig. 1. *Callithamnion rupicolum* Anders. Upper part of a spermatangial plant,  $\times 80$ .
- Fig. 2-3. *Callithamnion soccoriense* Taylor. Fig. 2, upper part of a spermatangial plant,  $\times 33$ ; Fig. 3, Detail of spermatangial clusters,  $\times 105$ .
- Fig. 4. *Callithamnion uncinatum* sp. nov. Branching habit of an upper part of a plant of the type collection,  $\times 40$ .





## PLATE 12

- Fig. 1-3. *Aglaothamnion cordatum* (Børg.) Feldm.-Maz. Fig. 1, A spermatangial branch,  $\times 370$ ; Fig. 2, Developing gonimoblast showing irregular cordate shape,  $\times 190$ ; Fig. 3, A tetrasporangial branch,  $\times 115$ .
- Fig. 4-5. *Aglaothamnion brodiaei* (Harv.) Feldm.-Maz. Fig. 4, a branch showing the unicellular hairs and young gonimoblasts,  $\times 50$ ; Fig. 5, Gonimoblast,  $\times 135$ .



## PLATE 13

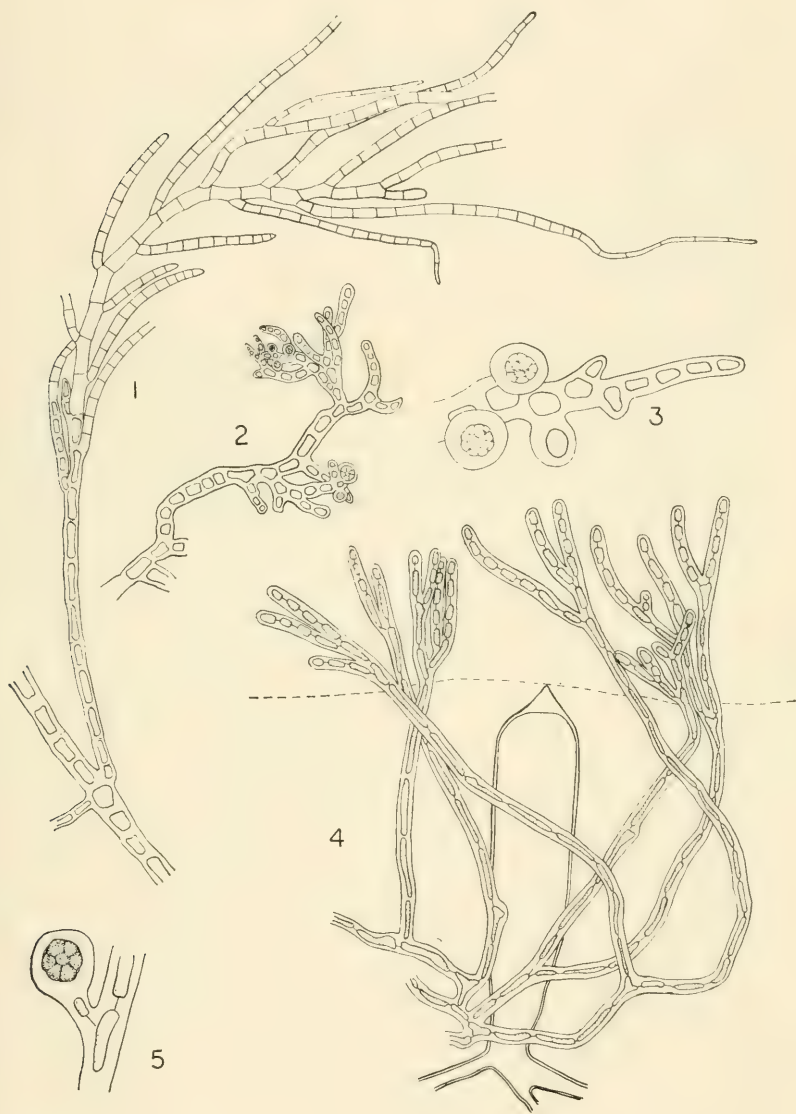
- Fig. 1-2. *Pleonosporium dasyoides* (J. Ag.) De Toni. Fig. 1, A spermatangial branch,  $\times 208$ ; Fig. 2, A polysporangial branch,  $\times 96$  (after Smith).
- Fig. 3. *Pleonosporium abysicola* Gard. Part of a plant of D. 9034,  $\times 96$ .
- Fig. 4. *Pleonosporium venustissimum* (Mont.) De Toni. A portion of the type collection from Callao, Peru (isotype slide in Herb. Hancock),  $\times 44$ .





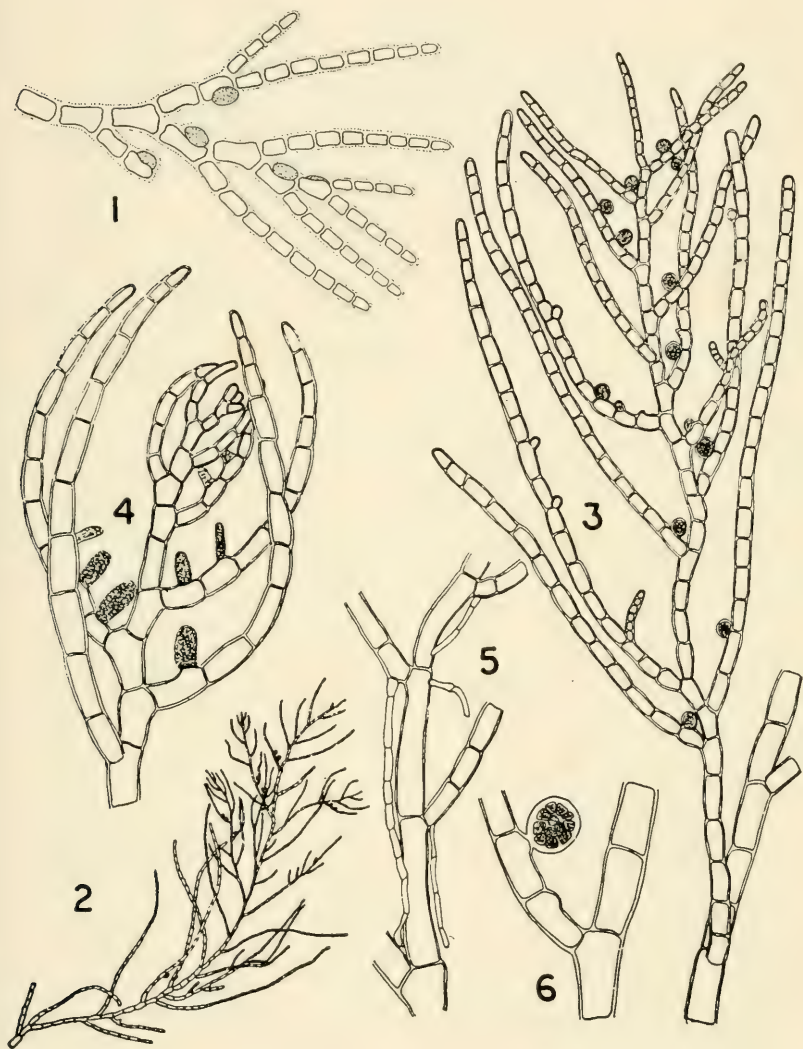
## PLATE 14

- Fig. 1-3. *Pleonosporium rhizoides* sp. nov., from the type collection. Fig. 1, upper portion of a sterile plant,  $\times 26$ ; Fig. 2, a specialized polysporangial branch system,  $\times 26$ ; Fig. 3, A polysporangial branch,  $\times 176$ .
- Fig. 4-5. *Pleonosporium codicolum* sp. nov., from the type collection. Fig. 4, Part of a plant shown in position with respect to the surface of the *Codium* host,  $\times 50$ ; Fig. 5, A polysporangium,  $\times 160$ .



## PLATE 15

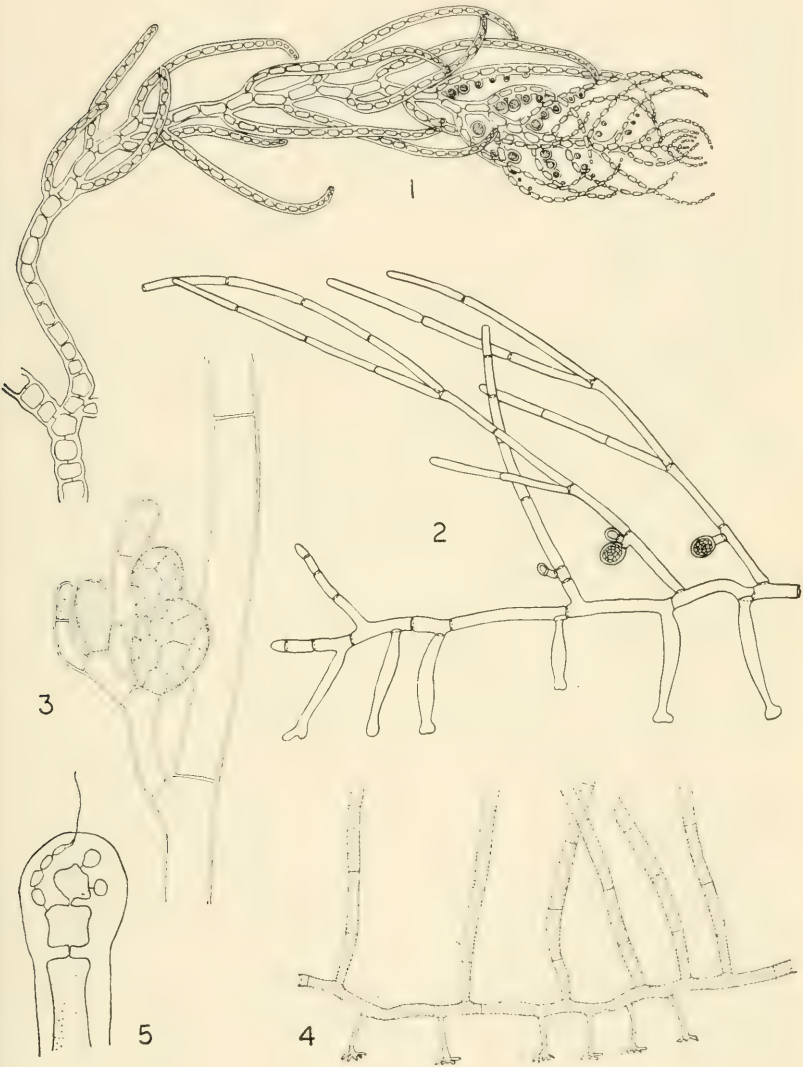
- Fig. 1. *Antithamnion breviramosus* Daws. A determinate ramulus from the type collection,  $\times 300$ .
- Fig. 2-6. *Pleonosporium globuliferum* Levr. (after Levring). Fig. 2, Habit,  $\times 6$ ; Fig. 3, Upper part of a plant with polysporangia,  $\times 30$ ; Fig. 4, Apex of a spermatangial branch,  $\times 100$ ; Fig. 5, Lower part of an axis with rhizoids,  $\times 100$ ; Fig. 6, A polysporangium,  $\times 100$ .





## PLATE 16

- Fig. 1. *Pleonosporium mexicanum* sp. nov. Upper part of a sporangial plant of the type collection,  $\times 25$ .
- Fig. 2. *Tiffaniella saccorhiza* (S. & G.) Doty & Meñez. Habit of part of a sporangial plant of the type collection,  $\times 37.5$  (after Setchell & Gardner).
- Fig. 3-5. *Spermothamnion snyderae* Farlow. Fig. 3, A group of developing polysporangia,  $\times 160$ ; Fig. 4, a rhizome showing rhizoids,  $\times 16$  (both after Smith); Fig. 5, A carpogonial branch  $\times 237$ .



## PLATE 17

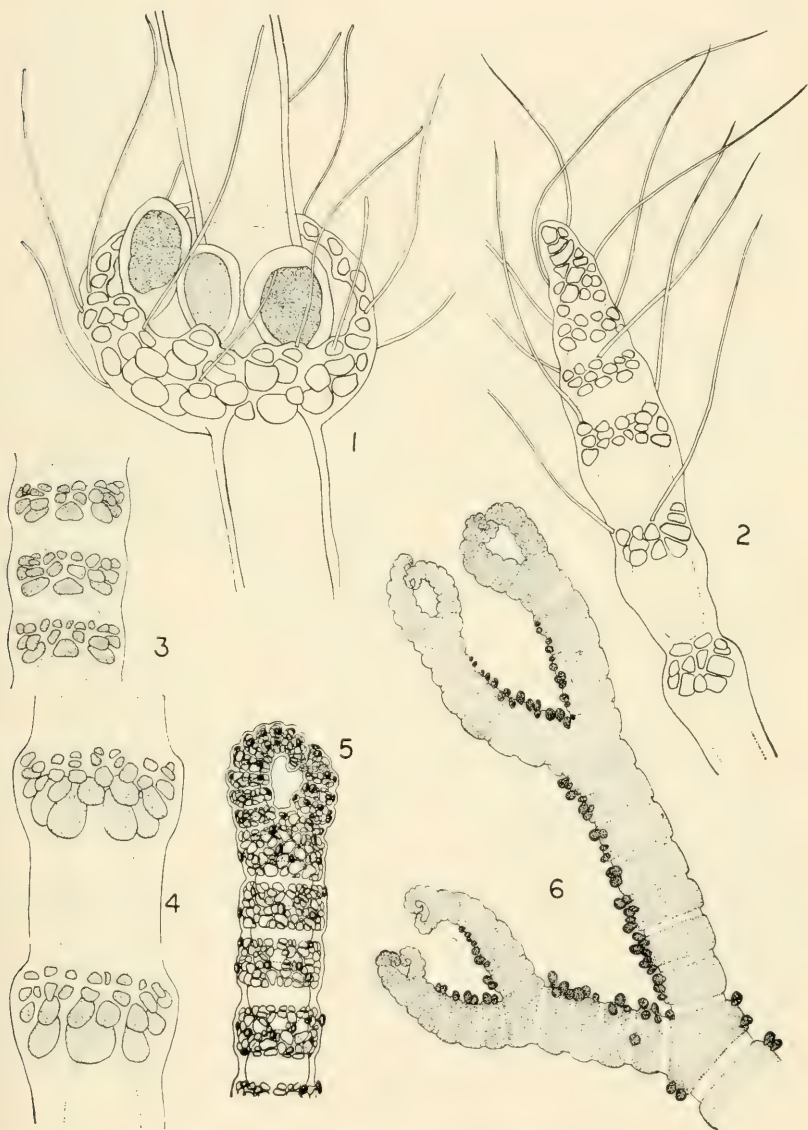
- Fig. 1-5. *Lejolisia colombiana* Tayl. Fig. 1-2, Tetrasporangial branches,  $\times 100$  (after Taylor); Fig. 3-4, Spermatangial branches, 100 (after Taylor); Fig. 5, a cystocarp,  $\times 150$ .
- Fig. 6. *Ceramium affine* S. & G. A tetrasporangial branch,  $\times 240$ .
- Fig. 7. *Pleonosporium rhizoides* sp. nov. Lower part of an axis of the type collection, showing abundant descending rhizoids,  $\times 33$ .
- Fig. 8. *Ceramium camouii* Daws. Part of a tetrasporangial axis showing three closed involucre (compare with Pl. 18, fig. 1),  $\times 200$ .
- Fig. 9-10. *Ceramium affine* var. *peninsularis* Daws. Fig. 9, Part of a sterile axis,  $\times 225$ ; Fig. 10, a tetrasporangial node,  $\times 330$ .





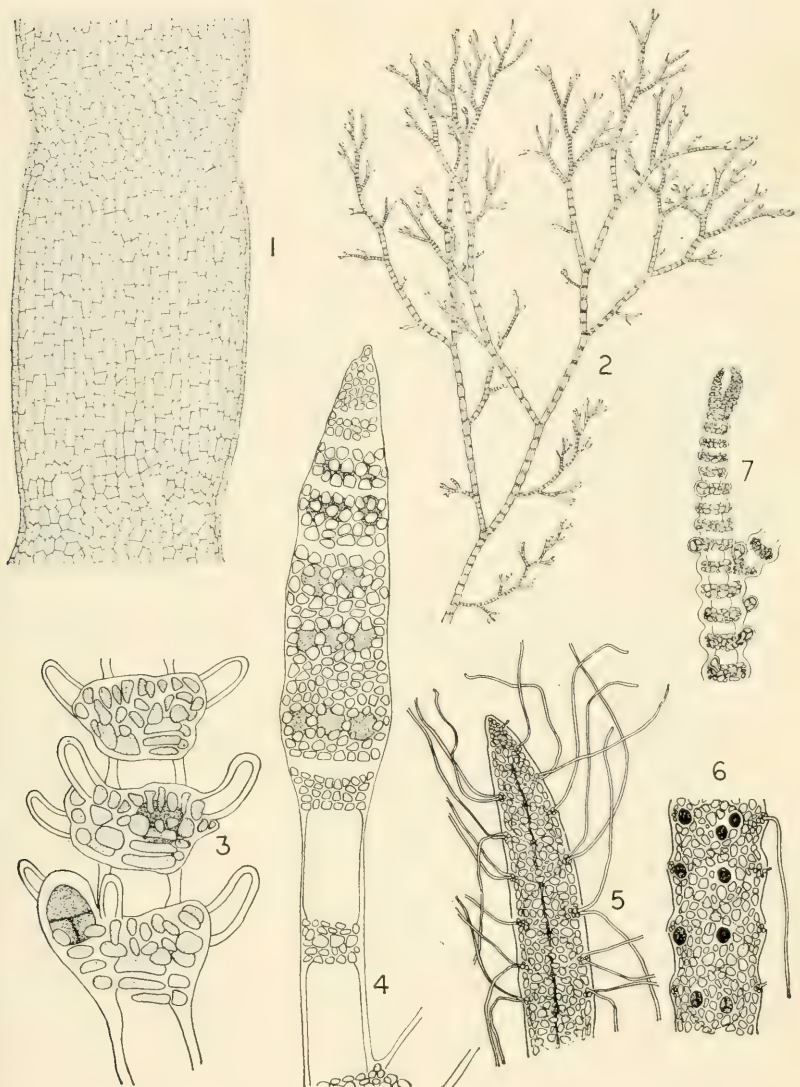
## PLATE 18

- Fig. 1-2. *Ceramium camouii* Daws. Fig. 1, An open, much-expanded tetrasporangial involucre from the type collection,  $\times 300$ ; Fig. 2, tip of a sterile axis from the type collection,  $\times 200$ .
- Fig. 3-4. *Ceramium caudatum* S. & G. Fig. 3, Young nodes of a sterile filament,  $\times 250$ ; Fig. 4, Older nodes of same filament,  $\times 350$ .
- Fig. 5-6. *Ceramium clarionense* S. & G. Terminal part of a sterile filament showing nodal bands and gland cells,  $\times 81$ ; Fig. 6, Upper part of a tetrasporangial plant, the cells not shown,  $\times 55$ .



## PLATE 19

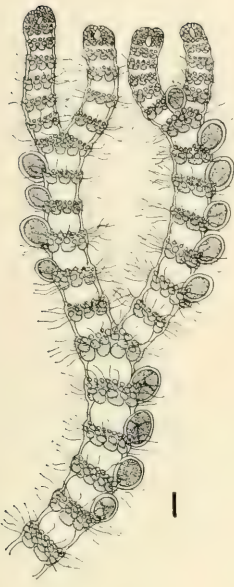
- Fig. 1-2. *Ceramium eatonianum* (Farl.) De Toni. Fig. 1, Part of an axis showing complete cortication and gland cells,  $\times 160$ ; Fig. 2, Upper part of a branched axis,  $\times 3$ .
- Fig. 3. *Ceramium fimbriatum* S. & G. Part of a tetrasporangial axis,  $\times 230$ .
- Fig. 4. *Ceramium equisetoides* Daws. One of the stichidium-like tetrasporangial branches,  $\times 200$ .
- Fig. 5-6. *Ceramium codicola* J. Ag. A sterile tip and part of a tetrasporangial axis, respectively,  $\times 55$  (after S. & G.).
- Fig. 7. *Ceramium caudatum* S. & G. Part of a tetrasporangial axis (but the cortical cells apparently not accurately drawn)  $\times 67$  (after S. & G.).





## PLATE 20

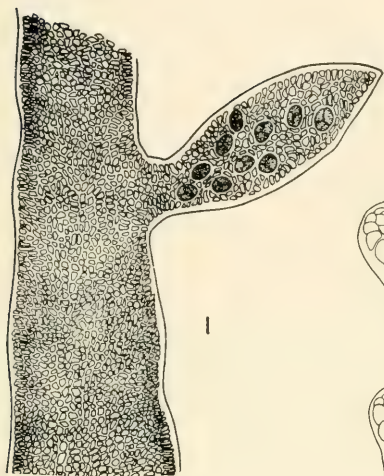
- Fig. 1. *Ceramium caudatum* S. & G. Upper part of a tetrasporangial plant from southern California (type of *C. avalonae*).
- Fig. 2-3. *Ceramium gracillimum* var. *byssoides*. (Harv.) Feldm.-Maz. Portions of filaments of a coarse form and a slender form,  $\times 250$ .
- Fig. 4. *Ceramium californicum*. J. Ag. Part of a filament about 1 cm. below the apex,  $\times 100$ .
- Fig. 5. *Ceramium codicola* J. Ag. One of the bulb-tipped, pigmented rhizoids,  $\times 120$ .
- Fig. 6-7. *Ceramium fimbriatum* S. & G. Fig. 6, Upper part of a plant; Fig. 7, Terminal part of an axis,  $\times 125$  (after S. & G.).



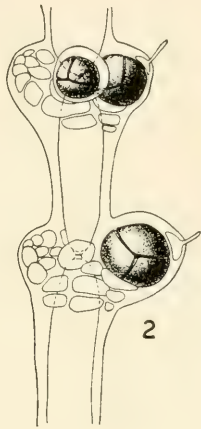
## PLATE 21

(all after Setchell &amp; Gardner)

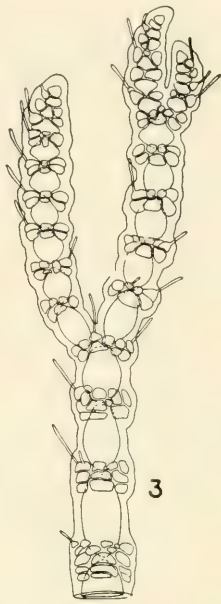
- Fig. 1. *Ceramium howellii* S. & G. A small lower part of an axis with a tetrasporangial branchlet,  $\times 100$ .
- Fig. 2-3. *Ceramium gracillimum* var. *byssodeum* (Harv.) Feldm.-Maz. Fig. 2, Two mature tetrasporangial nodes,  $\times 165$ ; Fig. 3, A sterile axis,  $\times 165$ .
- Fig. 4-5. *Ceramium evermannii* S. & G. Parts of sterile and tetrasporangial axis, respectively,  $\times 82$ .



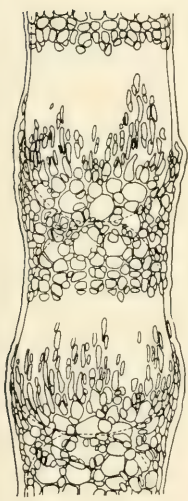
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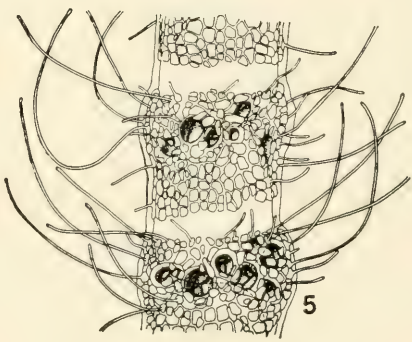
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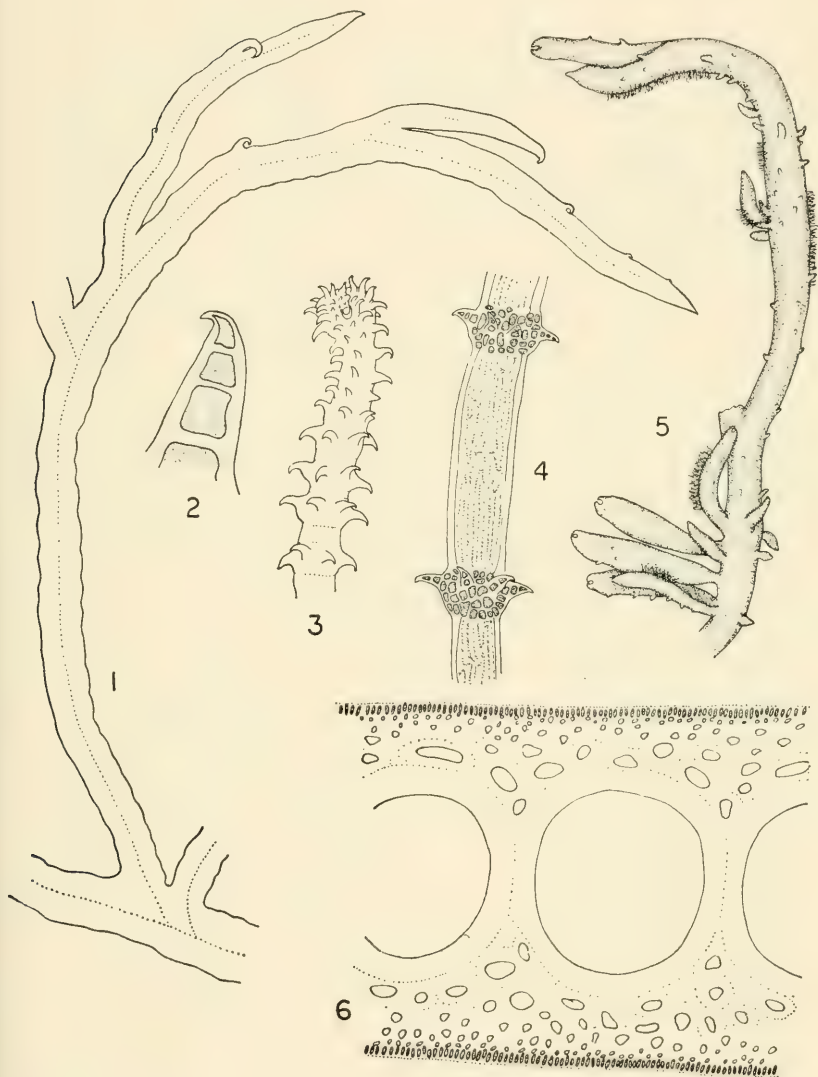
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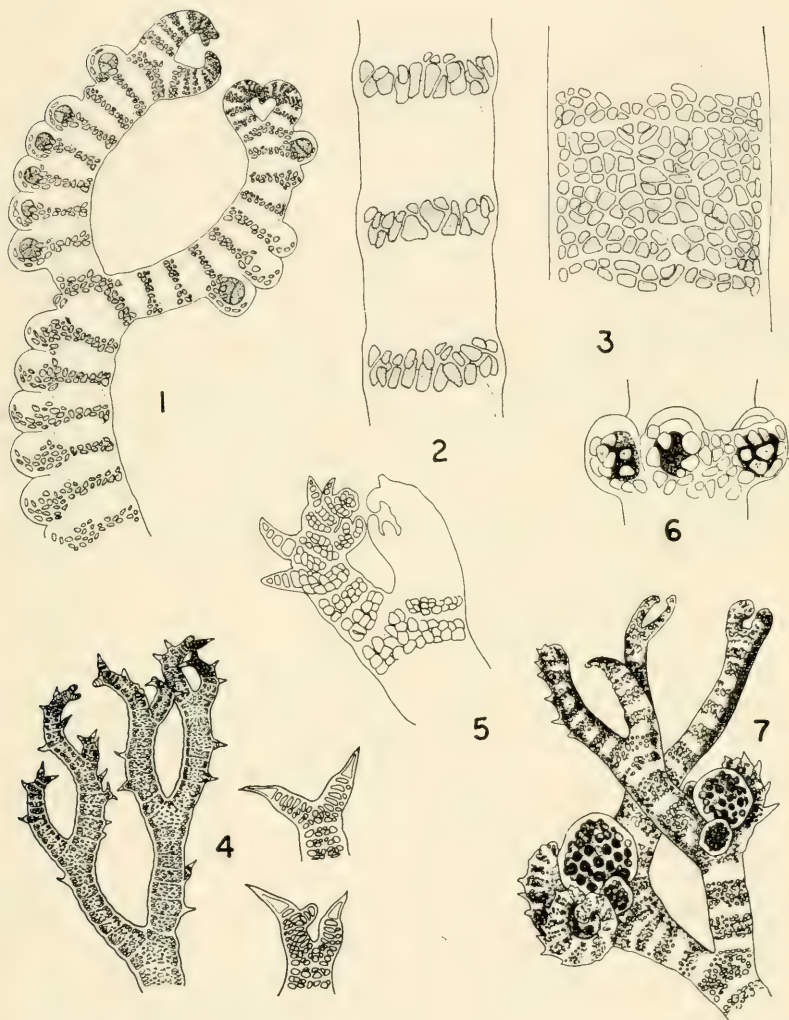
## PLATE 22

- Fig. 1. *Ceramium howellii* S. & G. Outline of upper part of a plant to show sparse branching and incurved tips,  $\times 16$ .
- Fig. 2-4. *Ceramium hamatispinum* Daws. Fig. 2, A single multicellular spine,  $\times 550$ ; Fig. 3, Outline of apical part of a filament,  $\times 85$ ; Fig. 4, Part of an old filament to show persistent, whorled spines,  $\times 100$ .
- Fig. 5-6. *Ceramium obesum* Daws. Fig. 5, A plant from the type collection showing coarse, forcipate tips and rhizoids,  $\times 5$ ; Fig. 6, Longitudinal section through a main axis to show thick cortex,  $\times 55$ .



## PLATE 23

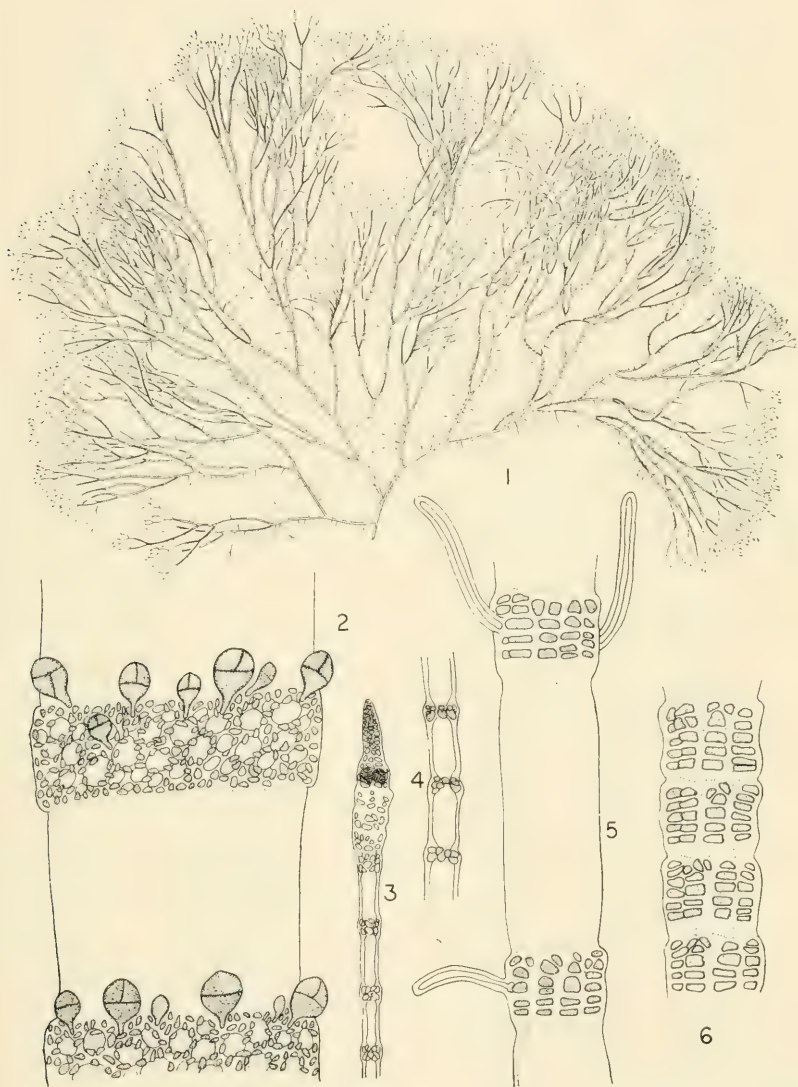
- Fig. 1-2. *Ceramium mazatlanense* Daws. Fig. 1, A young tetrasporangial plant with abaxial sporangia,  $\times 100$ ; Fig. 2, Sterile nodes,  $\times 200$ .
- Fig. 3. *Ceramium pacificum* (Collins) Kylin. A young sterile node,  $\times 190$ .
- Fig. 4. *Ceramium horridum* S. & G. Upper part of a plant ( $\times 36$ ) and two apices to show spines ( $\times 100$ ) (after S. & G.).
- Fig. 5-7. *Ceramium paniculatum* Okam. (after Okamura) Fig. 5, Apex to show multicellular spines,  $\times 120$ ; Fig. 6, A tetrasporangial node,  $\times 175$ ; Fig. 7, Part of a cystocarpic plant,  $\times 64$ .





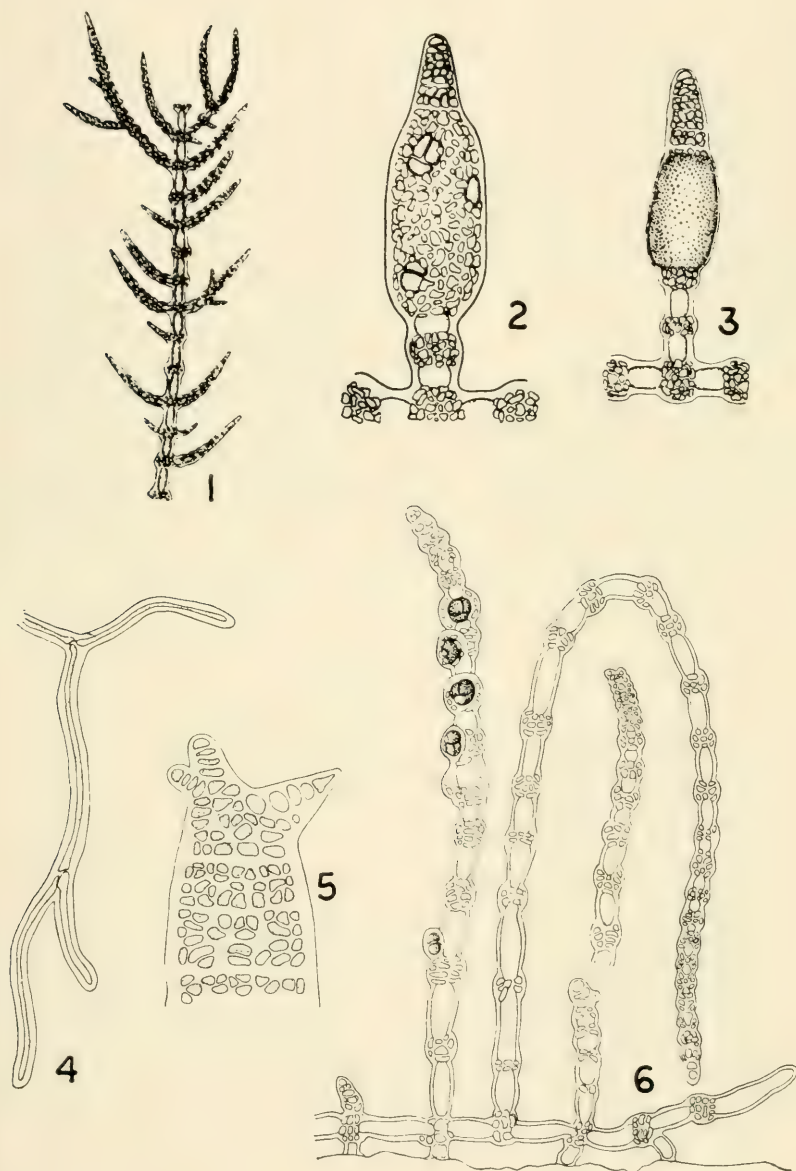
## PLATE 24

- Fig. 1. *Ceramium pacificum* (Collins) Kylin. Habit,  $\times 0.425$  (after Smith).
- Fig. 2. *Ceramium ornatum* S. & G. Part of a tetrasporangial filament from the type collection,  $\times 100$ .
- Fig. 3-4. *Ceramium procumbens* S. & G. Fig. 3, a tetrasporangial branch,  $\times 75$ ; Fig. 4, Part of a sterile filament,  $\times 155$ .
- Fig. 5-6. *Ceramium recticorticum* Daws. Portions of filaments near the base and near the apex, respectively,  $\times 210$ .



## PLATE 25

- Fig. 1-3. *Ceramium procumbens* S. & G. (after Setchell & Gardner) Fig. 1, Habit of part of a prostrate filament to show opposite branching,  $\times$  30; Fig. 2, A tetrasporangial branch,  $\times$  125; Fig. 3, A spermatangial branch,  $\times$  125.
- Fig. 4-5. *Ceramium sinicola* S. & G. Fig. 4, A branched, penetrating rhizoid,  $\times$  120; Fig. 5, Apex of a filament to show spine,  $\times$  300.
- Fig. 6. *Ceramium serpens* S. & G. Habit of a tetrasporangial plant,  $\times$  125 (after Setchell & Gardner).



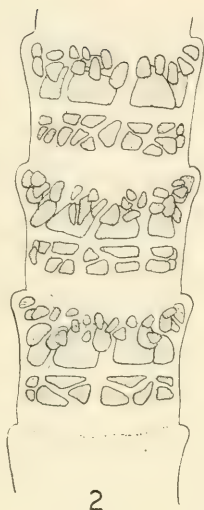


## PLATE 26

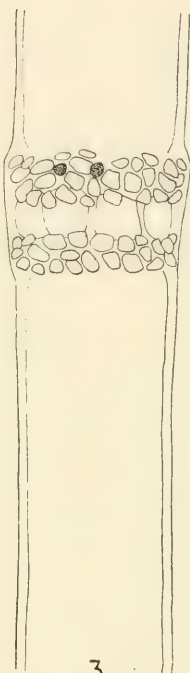
- Fig. 1-3. *Ceramium taylorii* Daws. Fig. 1, Tip of a tetrasporangial axis,  $\times 150$ ; Fig. 2, Series of cortical bands about 1 mm. from a sterile tip,  $\times 250$ ; Fig. 3, A cortical band in lower part of an axis showing extended internodes,  $\times 250$ .
- Fig. 4-6. *Ceramium zaca* S. & G. Fig. 4, Upper part of a tetrasporangial axis,  $\times 150$ ; Fig. 5, Young cortical bands,  $\times 225$ ; Fig. 6, Older cortical bands,  $\times 350$ .
- Fig. 7. *Centroceras clavulatum* (Ag.) Mont. Detail of cortex showing cell arrangement and whorled spines,  $\times 325$  (After Smith).



1



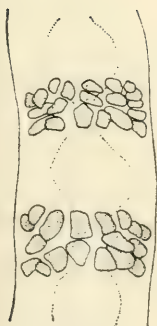
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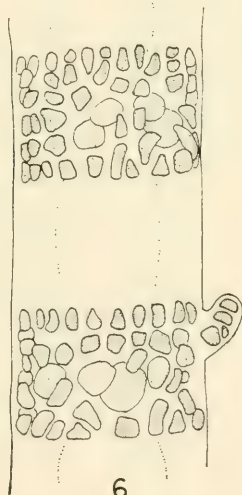
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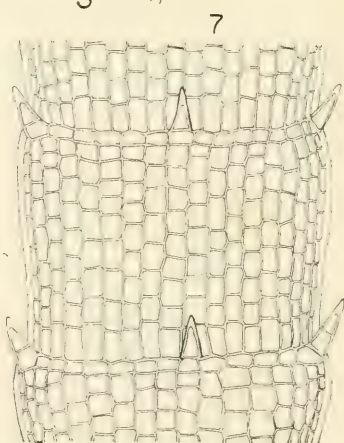
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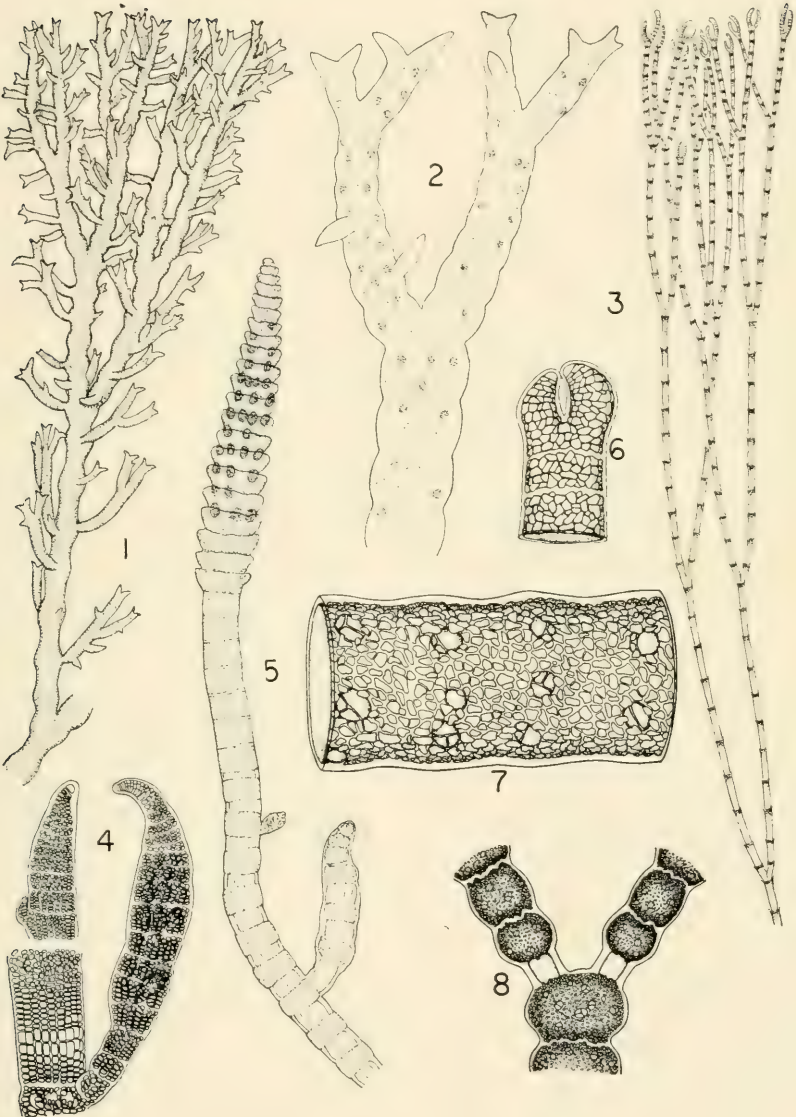
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## PLATE 27

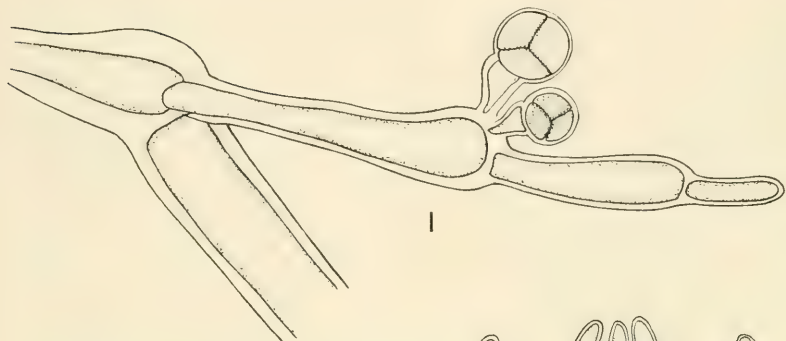
- Fig. 1-2. *Ceramium viscainoense* Daws. Fig. 1, Habit of part of the type,  $\times$  7.5; Fig. 2, Terminal part of a tetrasporangial branch,  $\times$  30.
- Fig. 3. *Centroceras clavulatum* (Ag.) Mont. Habit,  $\times$  10.
- Fig. 4. *Centroceras bellum* S. & G. Apex and tetrasporangial branch of the type,  $\times$  123 (after S. & G.).
- Fig. 5. *Ceramium vagabunde* Daws. Part of a tetrasporangial axis,  $\times$  34.
- Fig. 6-7. *Ceramium sinicola* S. & G. var. *sinicola*,  $\times$  100 (after Setchell & Gardner). Fig. 6, Apex of an axis; Fig. 7, Portion of a mature tetrasporangial axis.
- Fig. 8. *Ceramium sinicola* var. *interruptum* (S. & G.) Daws. Part of an old tetrasporangial axis,  $\times$  40 (after Setchell & Gardner).



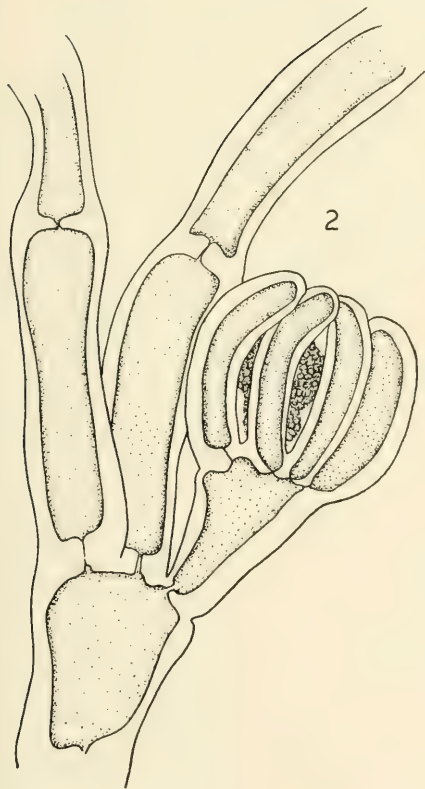


## PLATE 28

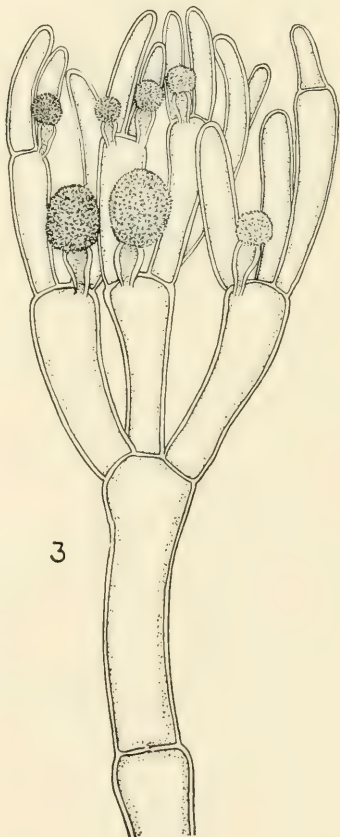
*Griffithsia anthericephala* Daws. Fig. 1, A tetrasporangial branch from a topotype,  $\times 141$ ; Fig. 2, A cystocarpic branch from a topotype,  $\times 125$ ; Fig. 3, A spermatangial branch from the holotype,  $\times 85$ .



1



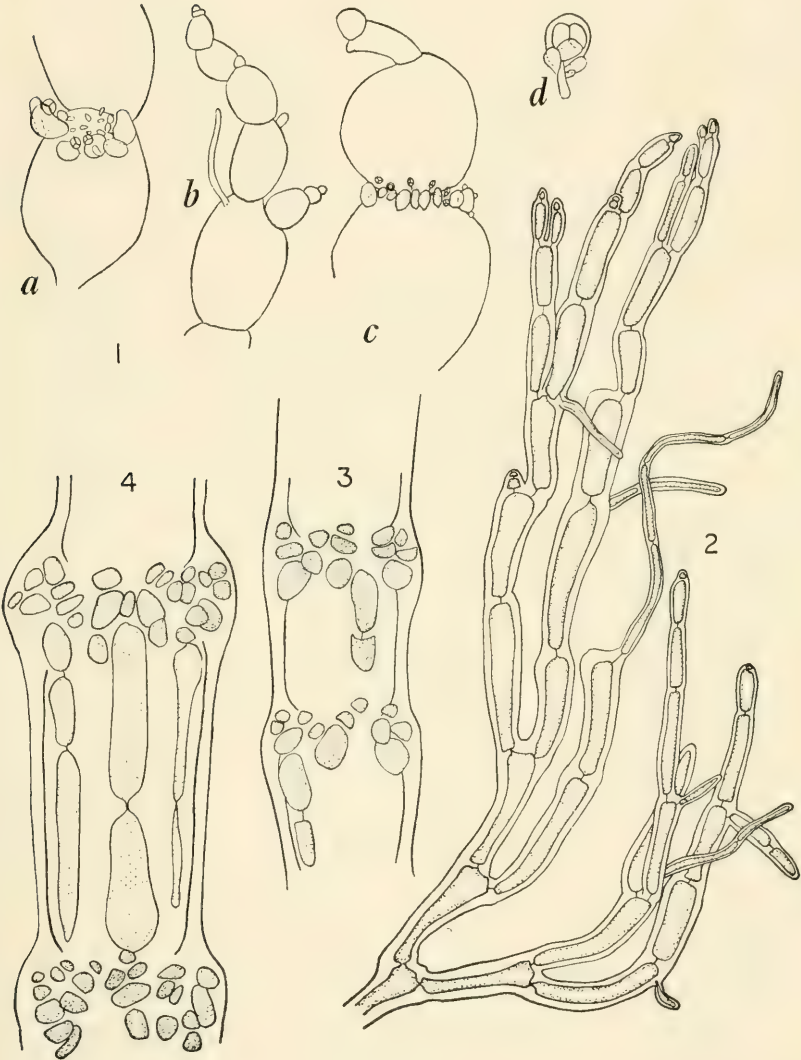
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## PLATE 29

- Fig. 1. *Griffithsia ovalis* Harv. a-c, Parts of a sterile and two tetrasporangial branches showing involucral cells,  $\times$  30, 16, 26, respectively; d, A pedicellate tetrasporangium,  $\times$  300 (all after Abbott).
- Fig. 2. *Griffithsia pacifica* Kylin, part of a rhizoid-bearing form of the species,  $\times$  13.
- Fig. 3-4. *Ceramium personatum* S. & G. A younger (3) and an older (4) node showing development of descending corticating rhizoidal filaments,  $\times$  330.





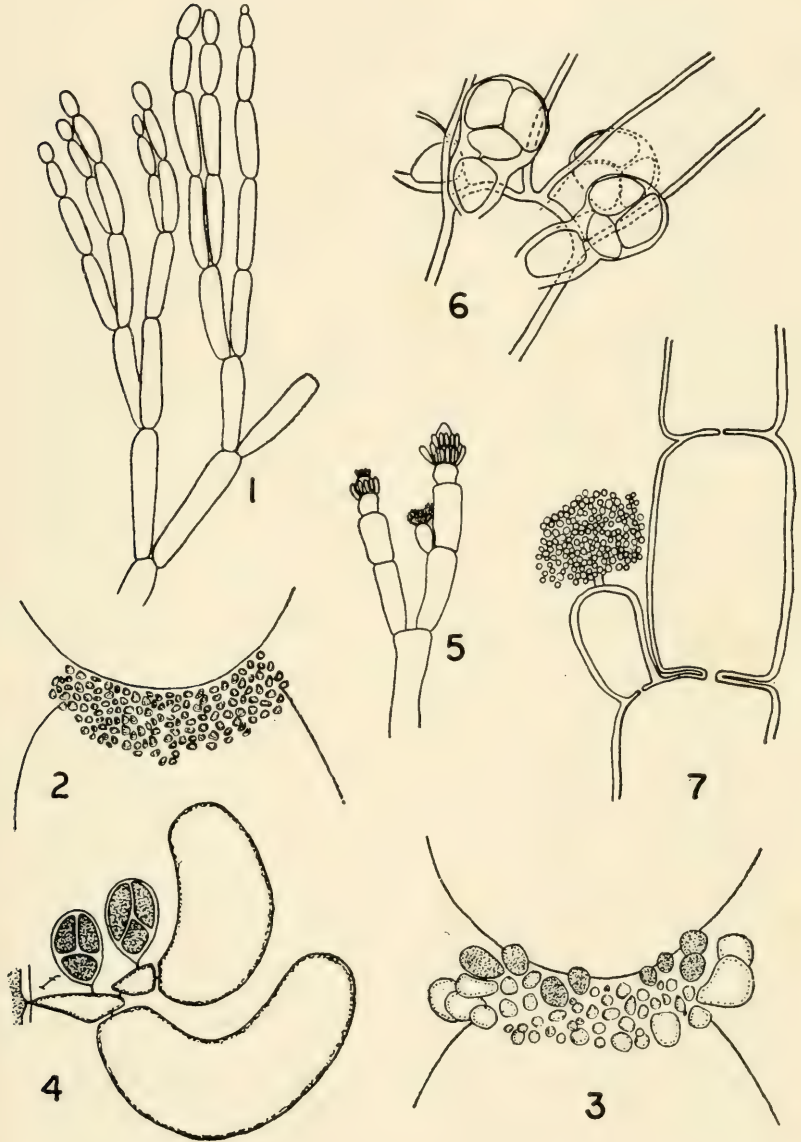
## PLATE 30

- Fig. 1-3. *Spyridia filamentosa* (Wulf.) Harv. Fig. 1, 2. Tips of axes with blunter and more attenuated branchlets, respectively,  $\times 10$ . Fig. 3. Two determine lateral branchlets showing cortical bands,  $\times 75$ . (after Børgesen).
- Fig. 4-5. *Microcladia coulteri* Harv. Fig. 4. Habit of upper part of a plant,  $\times 2$ . Fig. 5, A cystocarpic branch,  $\times 7.5$  (after Smith).
- Fig. 6. *Griffithsia pacifica*. Spermatangial cluster,  $\times 250$ .



## PLATE 31

- Fig. 1-4. *Griffithsia pacifica* Kylin. Fig. 1, upper part of a plant,  $\times 10$ ; Fig. 2, A young spermatangial node,  $\times 160$ ; Fig. 3, A young tetrasporangial node,  $\times 160$ ; Fig. 4, A mature tetrasporangial branch showing involucre cells,  $\times 150$  (after Kylin).
- Fig. 5-7. *Griffithsia tenuis* Ag. Fig. 5, Upper part of an axis showing whorled hairs,  $\times 40$ ; Fig. 6, A tetrasporangial node,  $\times 170$ . Fig. 7, A pedicellate spermatangial cluster,  $\times 400$  (after Abbott).

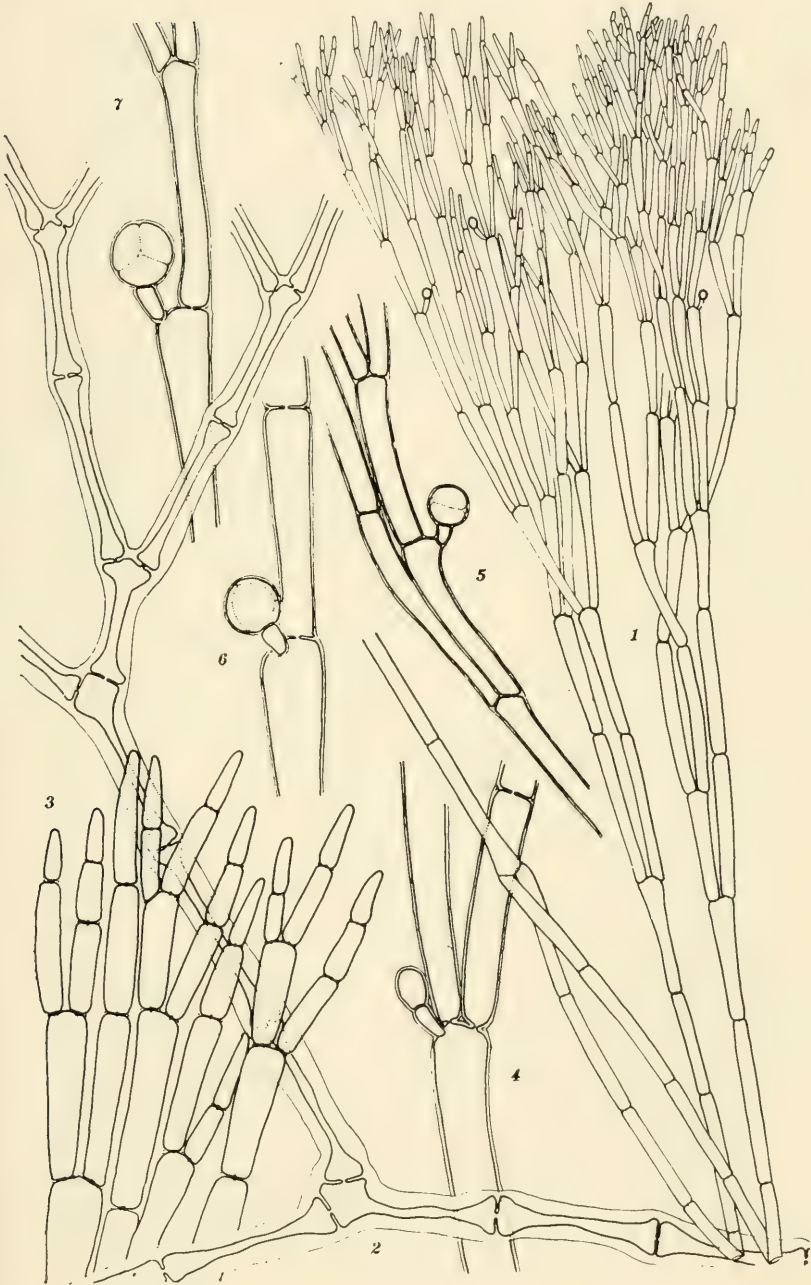


## PLATE 32

(all after Taylor)

*Griffithsia multiramosa* S. & G. Fig. 1. Habit of upper branching of a tetrasporic plant,  $\times 33$ . Fig. 2. Lower branches of the same plant,  $\times 33$ , Fig. 3, Tips of branchlet,  $\times 195$ . Fig. 4-7. Portions of branches with tetrasporangia (4, 6-7  $\times 130$ ; 5  $\times 75$ ).





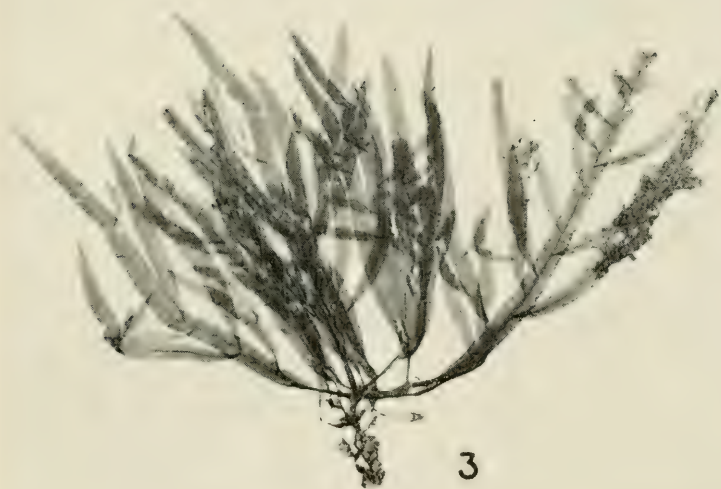
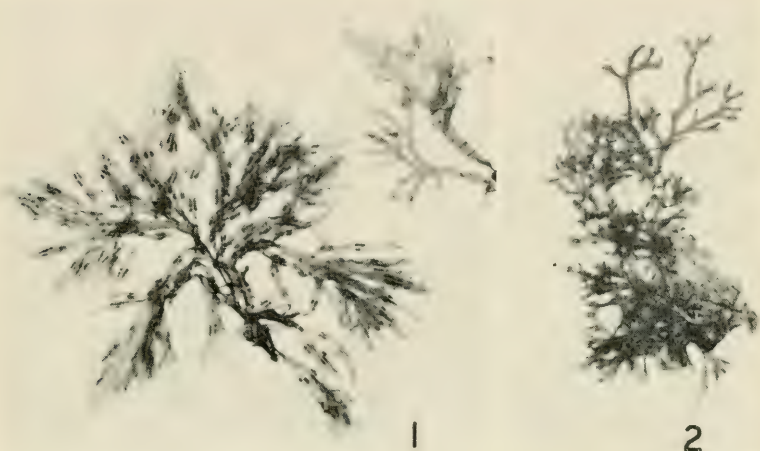
## PLATE 33

- Fig. 1-2. *Neopilota densa* (C. Ag.) Kylin. Fig. 1. A branch,  $\times 0.66$ . Fig. 2. Branchlet,  $\times 4$  (after Smith).
- Fig. 3-4. *Neoptilota filicina* (Farl.) J. Ag. Fig. 3. A branch,  $\times 0.66$ . Fig. 4. A branch,  $\times 4$ . (after Smith).
- Fig. 5-6. *Branchioglossum undulatum* Daws. Fig. 5. A cystocarp showing prominent rostrum,  $\times 34$ . Fig. 6. A spermatangial blade,  $\times 7.5$ .



## PLATE 34

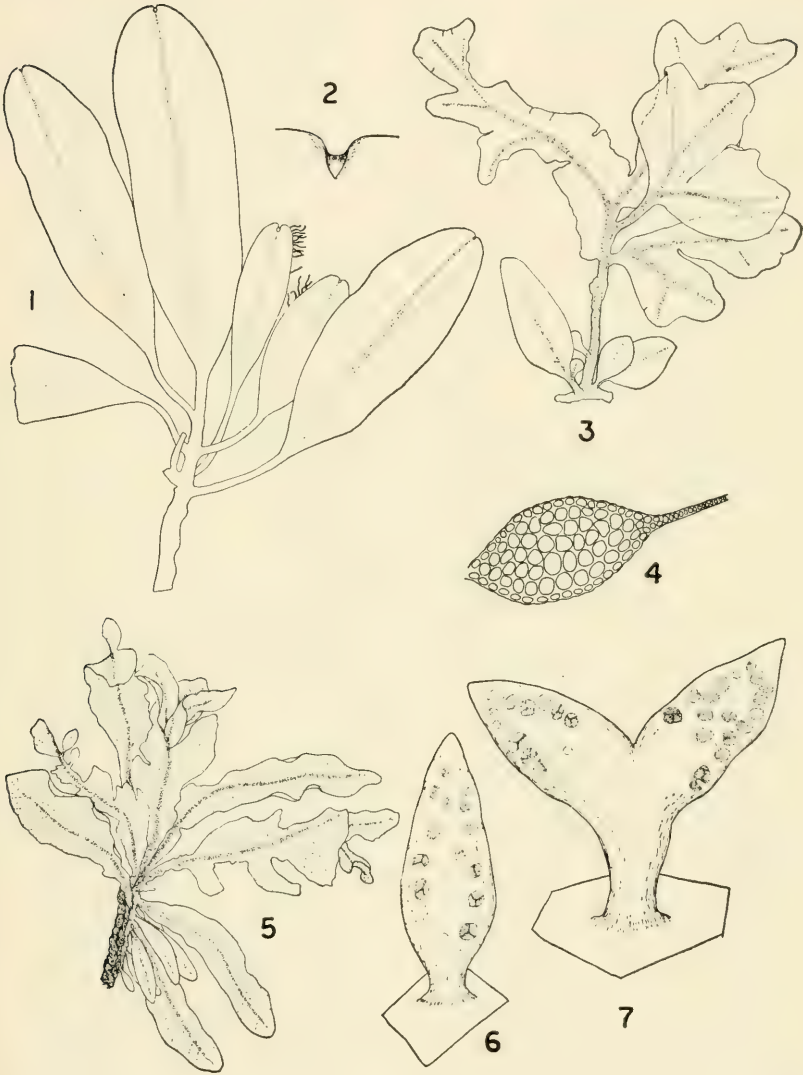
- Fig. 1. *Branchioglossum woodii* (J. Ag.) Kylin. Habit of a tetrasporangial plant,  $\times 1$ .
- Fig. 2. *Sorella delicatula* (Gard.) Holl. Habit,  $\times 3$ .
- Fig. 3. *Hypoglossum attenuatum* var. *abyssicolum* (Tayl.) Daws. Habit,  $\times 0.7$ .





## PLATE 35

- Fig. 1-2. *Hypoglossum retusum* Daws. Fig. 1, Habit,  $\times 6$ . Fig. 2. Detail of retuse apex of blade,  $\times 30$ .
- Fig. 3-4. *Schizoseris pygmaea* Daws. Fig. 3. Habit of young plant,  $\times 3$ . Fig. 4. Transection of a midrib and part of a blade.
- Fig. 5. *Membranoptera spatulata* Daws. Habit of a spermatangial plant,  $\times 3.3$ .
- Fig. 6-7. *Holmesia californica* (Daws.) Daws. A simple and a forked tetrasporangial branchlet,  $\times 33$ .



## PLATE 36

*Holmesia californica* (Daws.) Daws. A mature tetrasporangial plant,  
× 0.5.



## PLATE 37

- Fig. 1. *Taenioma perpusillum* (J. Ag.) J. Ag. Habit.
- Fig. 2. *Polyneurella hancockii* var. *rhizoides* Daws. Part of the margin of a blade of the type specimen showing rhizoids and proliferous bladelets,  $\times 5$ .
- Fig. 3-6. *Phycodrys profunda* Daws. Fig. 3-4. Sterile blades of D. 8456,  $\times 3$ . Fig. 5. A tetrasporangial blade with superficial sori,  $\times 5$ . Fig. 6. Margin of a blade of D. 5519 with lateral tetrasporangial outgrowths,  $\times 12.5$ .
- Fig. 7-8. *Phycodrys lucasana* Daws. Fig. 7. Part of the tetrasporangial type,  $\times 3.25$ . Fig. 8. One of the marginal rhizoid-bundle outgrowths,  $\times 30$ .





## PLATE 38

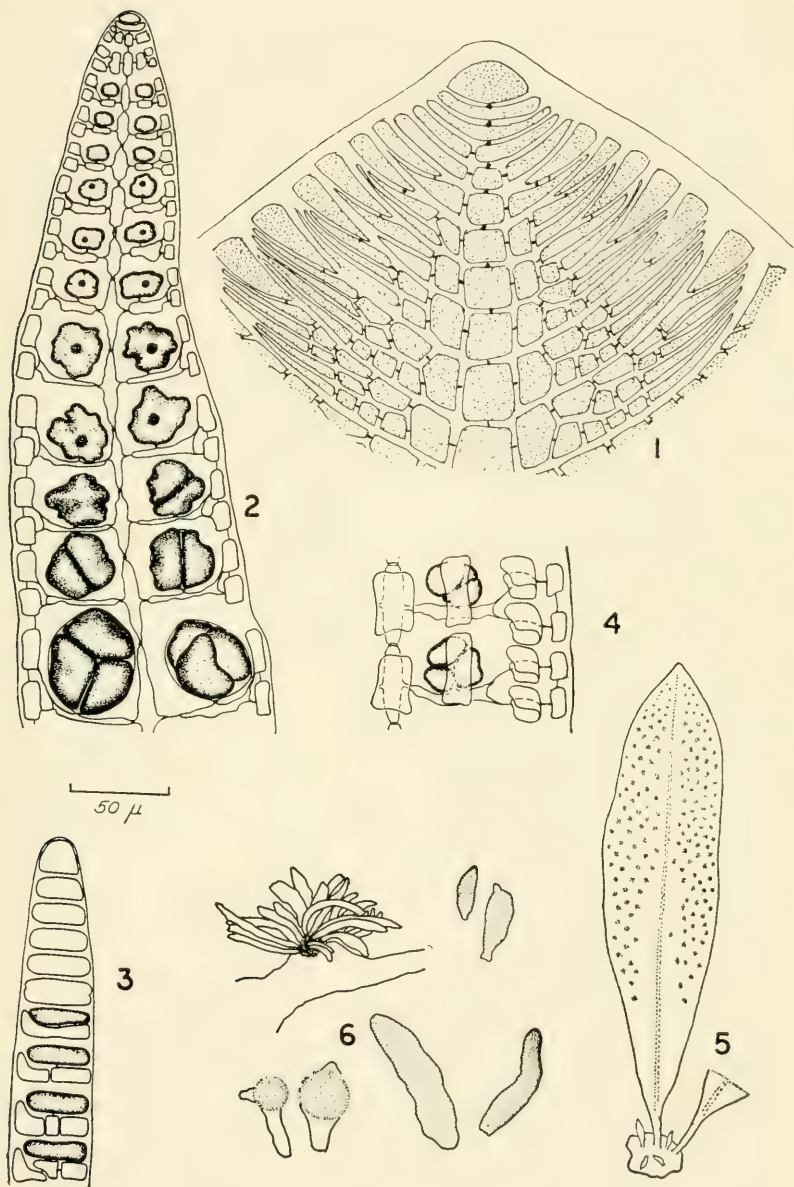
Fig. 1. *Sorella pinnata* Holl. Habit,  $\times$  2.

Fig. 2-3. *Phycodrys simplex* Daws. Habit of two specimens of the type collection,  $\times$  1.



## PLATE 39

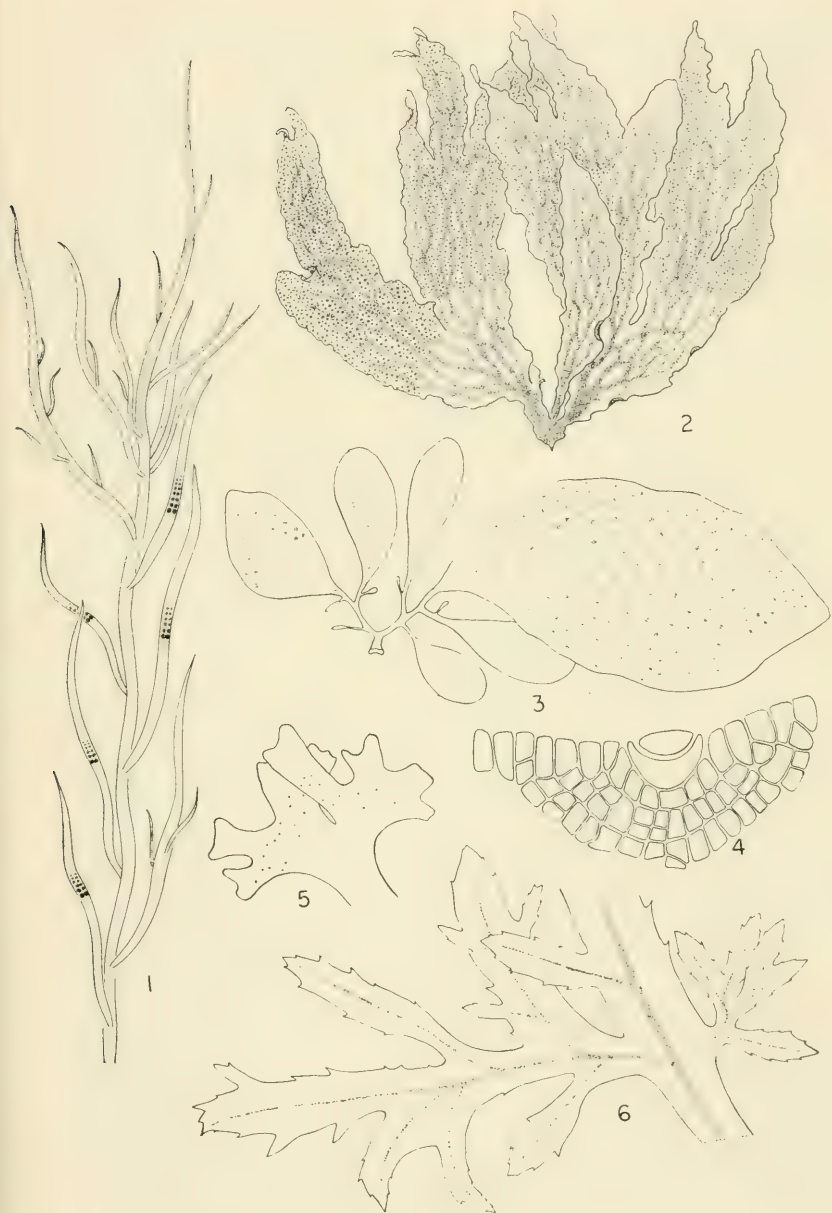
- Fig. 1. *Branchioglossum woodii* (J. Ag.) Kyl. Apex of a blade,  $\times$  860 (after Smith).
- Fif. 2-3. *Platysiphonia parva* Silva & Cleary. Fig. 2. Optical periclinal section of apex of a tetrasporangial blade. Fig. 3. Optical longisection of a tetrasporangial blade showing origin of sporangia and cover cells (After Silva & Cleary).
- Fig. 4. *Platysiphonia clevelandii* (Farl.) Papenf. Margin of a tetrasporangial blade to same scale as adjoining *P. parva* to show divided flanking cells (after Silva & Cleary).
- Fig. 5. *Grinnellia lanceolata* Daws. Part of a tetrasporangial plant,  $\times$  3.
- Fig. 6. *Polycoryne gardneri* Setch. A young thallus and pairs of mature cystocarpic, spermatangial and tetrasporic branches,  $\times$  11 (after Wagner).





## PLATE 40

- Fig. 1. *Platysiphonia clevelandii* (Farl.) Papenf. Habit,  $\times 8$  (after Smith).  
Fig. 2. *Polyneura latissima* (Harv.) Kylin. Habit,  $\times 0.6$  (after Smith).  
Fig. 3-4. *Polyneurella hancockii* Daws. Fig. 3. Habit,  $\times 0.8$ . Fig. 4. Detail of apex,  $\times 360$ .  
Fig. 5. *Myriogramme divaricata* Daws. Part of a tetrasporic blade,  $\times 1.6$ .  
Fig. 6. *Sorella pinnata* Holl. Branching habit,  $\times 8.5$ .



## PLATE 41

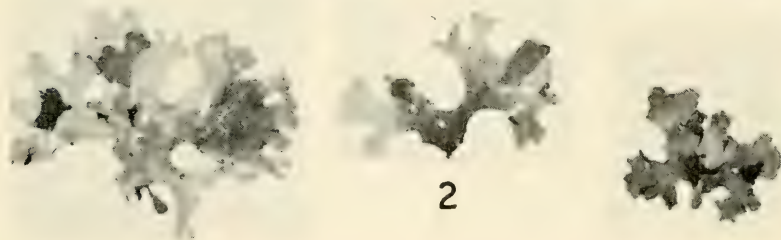
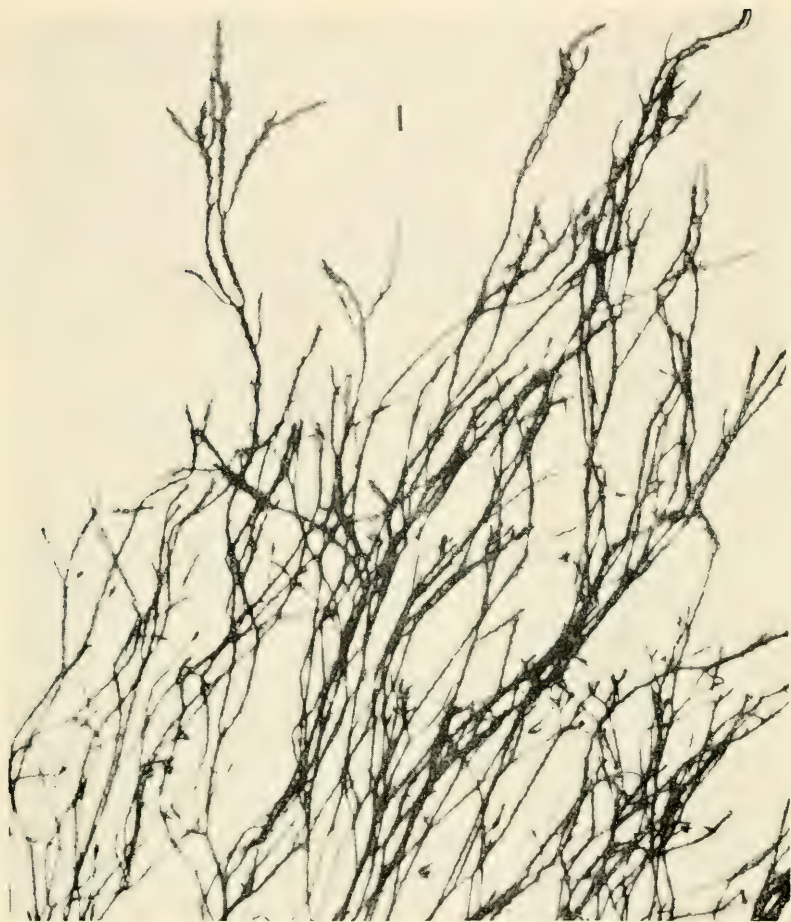
*Nienburgia andersoniana* (J. Ag.) Kylin. Two of the broader forms of the species,  $\times 1$ .



## PLATE 42

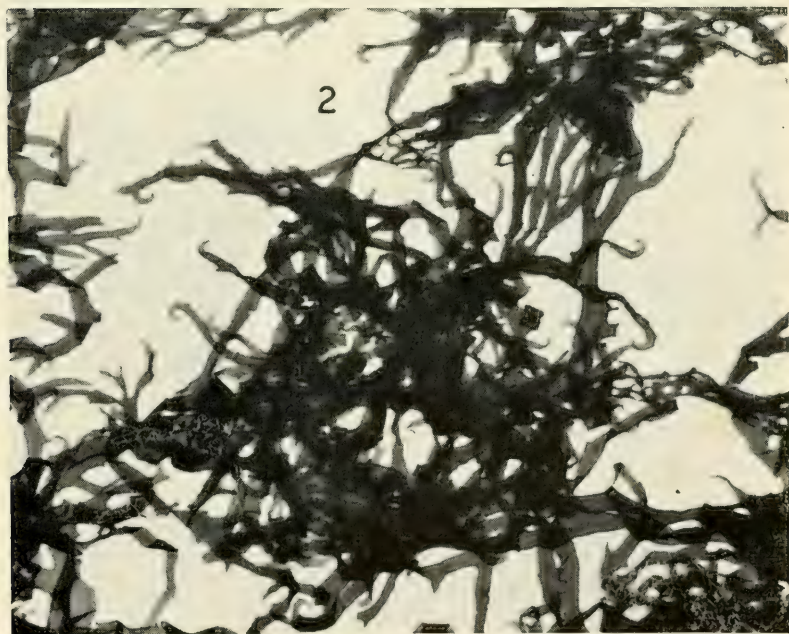
- Fig. 1. *Nienburgia andersoniana* (J. Ag.) Kylin. One of the extremely narrow forms of the species from Punta Pequeña,  $\times$  1.
- Fig. 2. *Myriogramme divaricata* Daws. Several specimens from the type collection,  $\times$  1.





## PLATE 43

- Fig. 1. *Phycodrys lucasana* Daws. Part of the tetrasporangial type collection,  $\times$  1.
- Fig. 2. *Acrosorium uncinatum* (Turn.) Kylin. Habit of part of an entangled plant to show hamate branches,  $\times$  2.



## PLATE 44

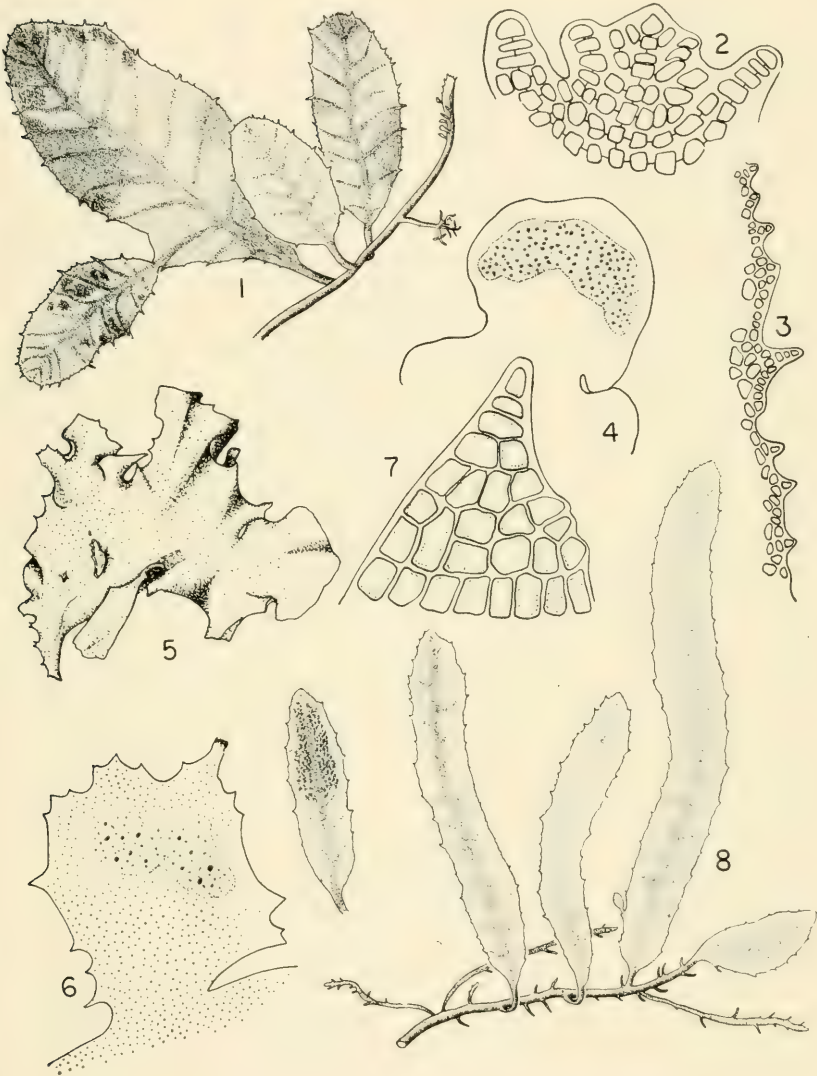
*Phycodrys amplissima* Daws. A spermatangial plant of the type collection,  $\times 1$ .





## PLATE 45

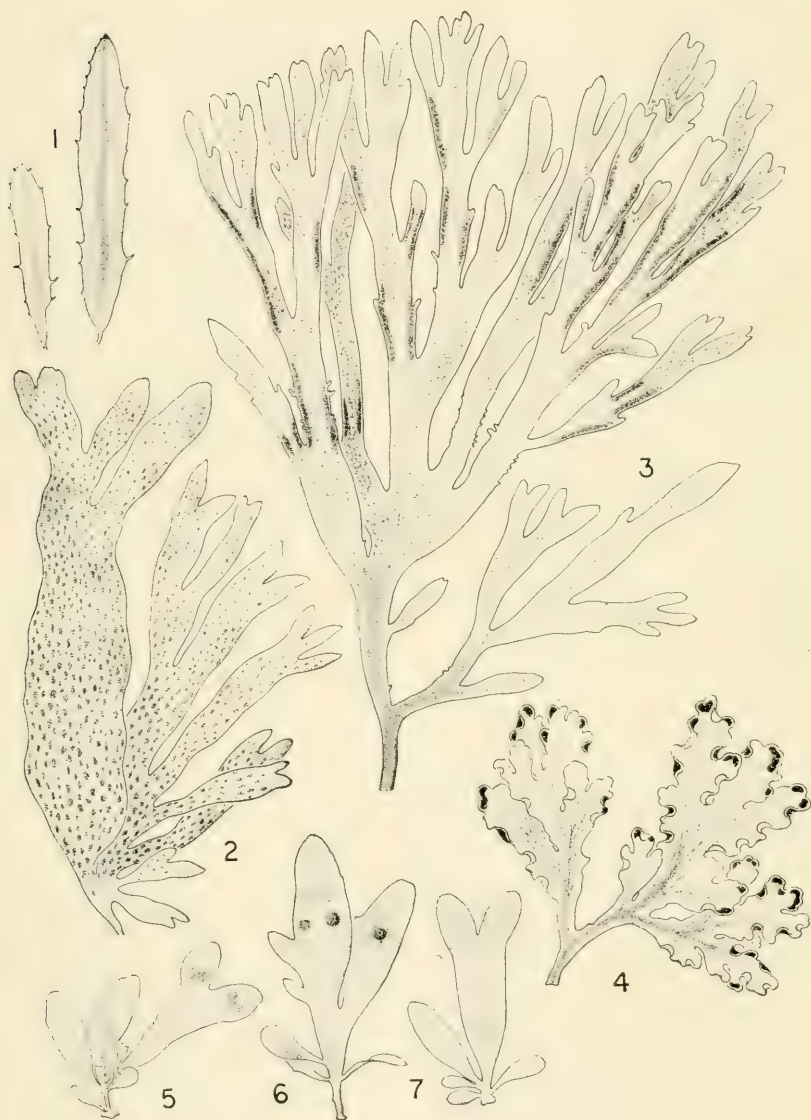
- Fig. 1. *Phycodrys setchellii* Skotts. Part of a small tetrasporangial plant showing blades from a decumbent stipe,  $\times 1.5$  (after Smith).
- Fig. 2-3. *Phycodrys amplissima* Daws. Fig. 2. Detail of apex of a branch,  $\times 325$ . Fig. 3. Detail of margin of a blade to show irregular microscopic teeth,  $\times 100$ .
- Fig. 4. *Cryptopleura imbricata*. A tetrasporangial lobe,  $\times 8$ .
- Fig. 5-7. *Haraldia prostrata* Daws., Neuch. & Wildm. from the type collection. Fig. 5. Habit of a blade from a congested group,  $\times 3.5$ . Fig. 6. A tetrasporangial lobe,  $\times 15$ . Fig. 7. A marginal spine,  $\times 300$ .
- Fig. 8. *Anisocladella pacifica* Kyl. A sterile plant,  $\times 2$  (right), and a tetrasporangial blade,  $\times 2$ . (These drawings from Smith (1944) are of exceptionally large, luxuriant plants from the Monterey, Calif., region. Mexican examples are usually less than half this size.)



## PLATE 46

(all after Smith)

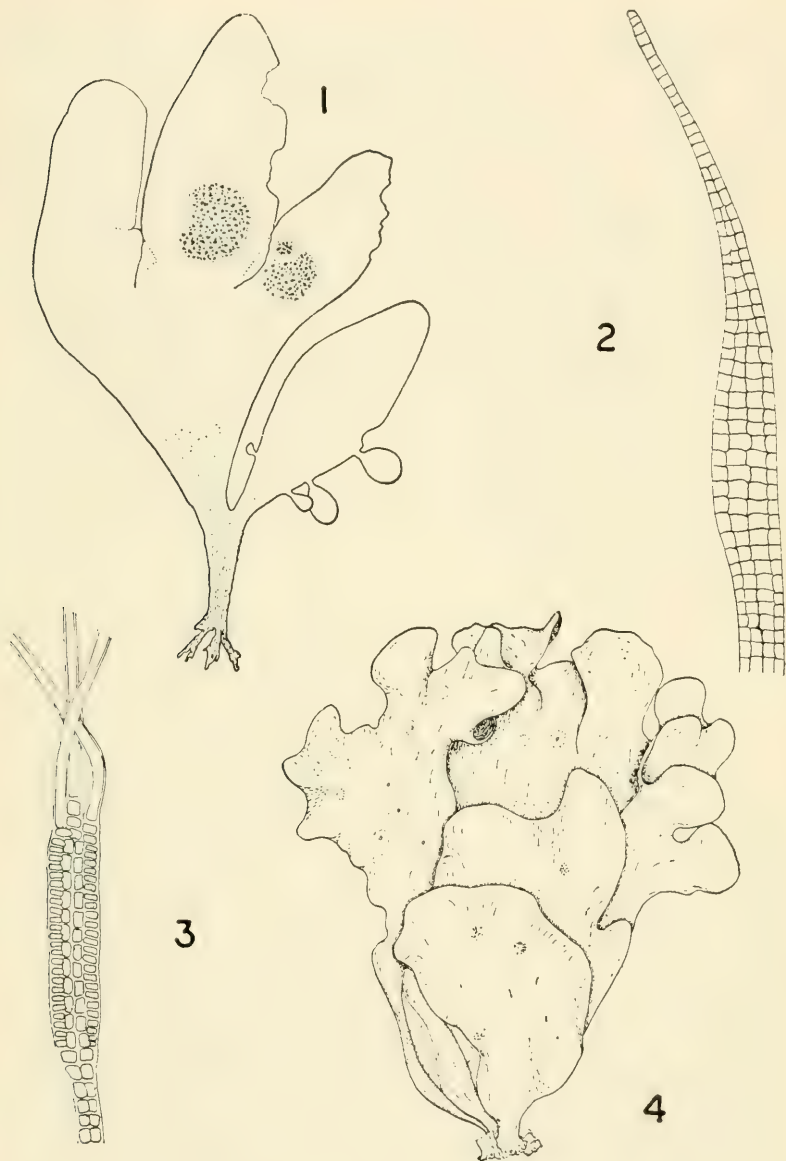
- Fig. 1. *Erythroglossum californicum* (J. Ag.) J. Ag. Habit,  $\times$  2.
- Fig. 2. *Myriogramme spectabilis* (Eaton) Kylin. Habit of a tetrasporangial plant,  $\times$  0.66.
- Fig. 3. *Cryptopleura violacea* (J. Ag.) Kylin. Habit of a tetrasporangial plant,  $\times$  0.5.
- Fig. 4. *Cryptopleura lobulifera* (J. Ag.) Kylin. Habit of a tetrasporangial plant,  $\times$  0.5.
- Fig. 5-7. *Myriogramme hollenbergii* Kylin. Habit of tetrasporangial, cystocarpic and spermatangial plants, respectively,  $\times$  2.



## PLATE 47

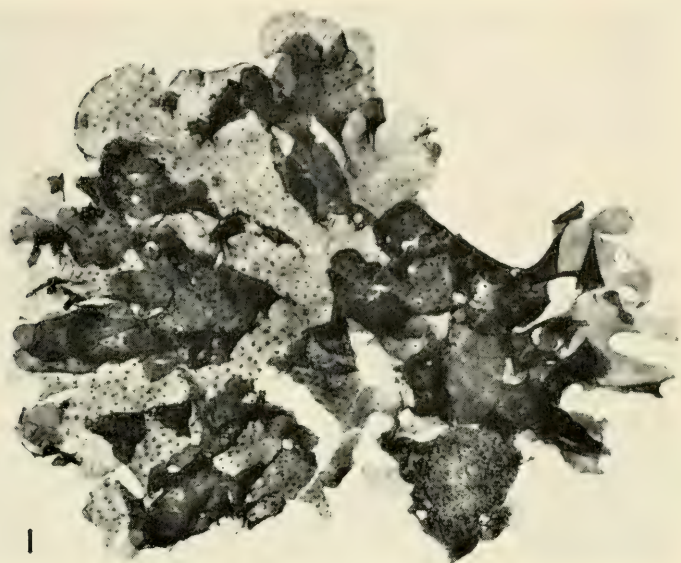
- Fig. 1. *Myriogramme osorioi* Daws. Habit of a tetrasporangial plant,  $\times 5.5$ .  
Fig. 2, Part of a transection of a mature blade.
- Fig. 3. *Taenioma perpusillum* (J. Ag.) J. Ag. A branch with three terminal hairs,  $\times 70$ .
- Fig. 4. *Myriogramme caespitosa* Daws. Habit of part of a cystocarpic plant dissected out of a cluster,  $\times 8$ .





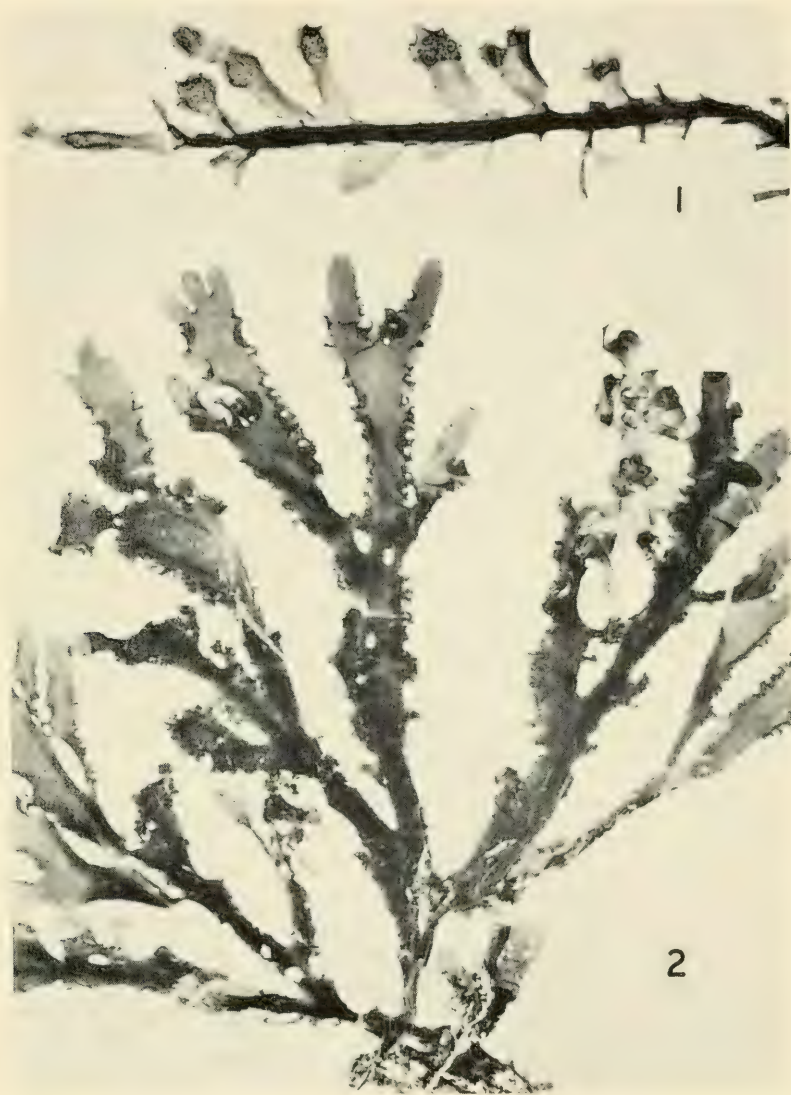
## PLATE 48

- Fig. 1. *Cryptopleura imbricata* Daws. Habit,  $\times$  1.8.  
Fig. 2. *Cryptopleura spatulata* Gard. Habit,  $\times$  0.9.



## PLATE 49

- Fig. 1. *Cryptopleura corallinara* (Nott) Gard. Habit of a plant on *Pterocladia*,  $\times 3$ .
- Fig. 2. *Cryptopleura crista* Kylin. Habit of a luxuriant plant on *Corallina*,  $\times 1$ .





## PLATE 50

*Botryoglossum farlowianum* (J. Ag.) De Toni. Fig. 1. Habit of an entire plant,  $\times 0.5$ . Fig. 2. Part of a tetrasporangial blade,  $\times 1$  (after Smith).





ALLAN HANCOCK PACIFIC EXPEDITIONS

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